TAXONOMY OF *BROMUS* (POACEAE: POOIDEAE: BROMEAE) SECTIONS *BROMOPSIS*, *BROMUS*, AND *GENEA* IN BRITISH COLUMBIA, CANADA

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ABSTRACT

A taxonomic treatment of *Bromus* sections *Bromopsis*, *Bromus* and *Genea* in British Columbia, Canada, is presented. Nineteen taxa are recognized, including six native and 12 introduced species, one with two varieties. The introduced species *B. riparius*, promoted in western North America for forage, is reported from British Columbia for the first time, with discussion of its North American introduction history and morphology. *Bromus squarrosus* var. *villosus* is reported from British Columbia, representing the first report of this taxon for the province and for North America. *Bromus kalmii* var. *occidentalis* Vasey ex Beal is lectotypified. Keys for determining the species, synonymies, descriptions, distribution maps, representative specimens and illustrations are provided for each of the species.

RESUMEN

Se presenta un tratamiento taxonómico de *Bromus* secciones *Bromopsis*, *Bromus* y *Genea* en British Columbia, Canadá. Se reconocen diez y nueve taxa, que incluyen seis especies nativas y 12 introducidas, una con dos variedades. La especie introducida *B. riparius*, fomentada en el oeste de Norte América para forraje, se cita de British Columbia por primera vez, con discusión sobre su morfología e historia de su introducción en Norte América. Y se cita *Bromus squarrosus* var. *villosus* de British Columbia, siendo la primera cita de este taxon para la provincia y para Norte América. Se lectotipifica *Bromus kalmii* var. *occidentalis* Vasey ex Beal. Se aportan claves para identificar las especies, sinonimias, descripciones, mapas de distribución, especimenes representativos e ilustraciones de todas las especies.

Bromus L. is a large and taxonomically complex grass genus that includes more than 160 species distributed in temperate regions worldwide. The genus is distinguished from other grass genera by the combination of leaf sheaths that are closed for most of their length, awns that are inserted subapically and hairy appendages on the apices of the ovary (Clayton & Renvoize 1986). Approximately 80 *Bromus* species are currently recognized in North, Central and South America (Pavlick et al. 2003); 29 of these reportedly occur in Canada (Pavlick & Anderton 2007). Among the 10 Canadian provinces and three territories (Fig. 1), the westernmost and topographically diverse British Columbia has the greatest number of *Bromus* species. *Bromus* is the second-largest grass genus in British Columbia; only *Poa* L., with 31 species (Soreng 2007), has greater species richness in the province.

In North America most workers recognize five sections in *Bromus* (reviewed by Saarela et al. 2007), but multiple recent molecular phylogenetic studies indicate that not all are natural groups, particularly the globally widespread *B.* sect. *Bromopsis* Dumort., which appears to comprise distinct Sierra Madrean (Mexican), North American, South American and Eurasian lineages (e.g., Pillay & Hilu 1990, 1995; Saarela et al. 2007). More work is needed to clarify higher-level phylogenetic relationships in *Bromus*. Nonetheless, the traditionally recognized *Bromus* sections can generally be recognized morphologically and learning their key characteristics can greatly aid in species identification in the field and herbarium.

There has been considerable progress in clarifying lower-level taxonomic problems in *Bromus*. Several species that occur in North American have received recent taxonomic study, including: *B. ciliatus* L. and *B. richardsonii* Link (Peterson et al. 2002); *B. grandis* (Shear) Hitchc., *B. hallii* (Hitchc.) Saarela & P.M. Peterson and *B. orcuttianus* Vasey (Saarela et al. 2005); *Bromus catharticus* var. *elata* (E. Desv.) Planchuelo (Planchuelo 2006); and *B. carinatus* Hook. & Arn. (Barkworth et al. 2006). Similar recent taxonomic work has been conducted on taxa from South America (Massa et al. 2001, 2004; Saarela et al. 2006) and Eurasia (Sales 1993, 1994; Spalton 2002). Comprehensive taxonomic treatments of *Bromus* for North America north of Mexico

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Fig. 1. Map of Canada, with the 10 provinces and three territories indicated. British Columbia is the western-most Canadian province. Scale bar = 500 km.

have also recently been published (Pavlick 1995; Pavlick & Anderton 2007), but despite these resources, identifying species of *Bromus* can be notoriously difficult for many workers. In such large and difficult groups, geographically focused taxonomic treatments can greatly facilitate accurate identifications and provide more detailed information than is normally found in standard floras, be they regional or continental in scope. The most recent comprehensive treatment of *Bromus* for British Columbia, in *Illustrated Flora of British Columbia* (Douglas et al. 2001), takes a taxonomically conservative approach and no longer reflects current understanding of the genus. Another recent treatment (Stewart & Hebda 2000) is restricted geographically to only those species that occur in the Columbia Basin region of British Columbia. The purpose of this work is to provide a detailed and updated taxonomic treatment for *Bromus* in British Columbia, including a dichotomous key, synonymies, species descriptions, distribution maps and citations of representative specimens.

Bromus in British Columbia

Bromus in British Columbia includes multiple native and introduced species that are currently classified in four sections. Most of the introduced species are annuals classified in *B.* sects. *Bromus* (*B. briziformis* Fisch. & C.A. Mey., *B. commutatus* L., *B. hordeaceus* L., *B. japonicus* Thunb., *B. racemosus* L., *B. secalinus* L. and *B. squarrosus* L.) and *Genea* Dumort. (*B. diandrus* Roth, *B. sterilis* L. and *B. tectorum* L.). All of these (and other) introduced species in *B.* sects. *Bromus* and *Genea* occur throughout western North America, mostly north of Mexico (see Pavlick & Anderton 2007; Saarela & Peterson in press), and several have caused serious ecological disruption. In general, annual species can be distinguished from perennial species based on basal vegetative characteristics. In perennial *Bromus* species, the dried remains of the previous years' growth are normally present, whereas there is no previous years' growth in the annual species. In most cases the annual taxa are generally smaller in stature and have a more delicate appearance (with some exceptions, such as some individuals of the large annual, *B. diandrus*), compared to the perennial taxa. *Bromus* sect. *Bromus* is characterized by 3–5-nerved first glumes, 5–7-nerved second glumes and lemmas rounded over the backs, whereas B. sect. *Genea* is characterized by 1(–3)-nerved first glumes, 3(–5)-nerved second glumes and narrow, elongate lemmas. Species of B. sect. *Bromopsis* in British Columbia are perennials with 1(–3)-nerved first glumes, 3(–5)-nerved second glumes and lemmas rounded or slightly keeled over the backs (i.e., flattened dorsiventrally). Two B. sect. *Bromopsis* species in British Columbia are introduced: the highly invasive smooth brome (*B. inermis* Leyss.) and meadow brome (*B. riparius* Rehm.), which is reported here as part of the British Columbia flora for the first time. The remaining five B. sect. *Bromopsis* species in the province are native: *B. ciliatus* L., *B. pacificus* Shear, *B. pumpellianus* Scribn., *B. richardsonii* Link and *B. vulgaris* (Hook.) Shear. The remainder of the *Bromus* taxa in British Columbia are classified in B. sect. *Ceratochloa* (P. Beauv.) Griseb., a group that is widespread throughout the province and easily recognizable on the basis of its strongly laterally flattened and keeled glumes and lemmas. Species limits within B. sect. *Ceratochloa* are not clear, both in British Columbia and more broadly throughout western North America. Taxa in B. sect. *Ceratochloa* have been variously recognized at different ranks; in British Columbia these include *B. aleutensis* Trin. ex Griseb. [=*B. sitchensis* Bongard var. *aleutensis* (Trin. ex Griseb.) Hultén], *B. carinatus* Hook. & Arn., *B. marginatus* Steud. [=*B. carinatus* var. *marginatus* (Nees.) Barkworth & Anderton], *B. polyanthus* Scribn. ex Shear and *B. sitchensis* Bongard (e.g., Calder & Taylor 1968; Hitchcock et al. 1969; Hubbard 1969; Pavlick 1995; Douglas et al. 2001; Clayton et al. 2002 onwards; Barkworth et al. 2006; Pavlick & Anderton 2007). Because taxon circumscriptions are not clear in B. section *Ceratochloa*, the section is not treated here (although it is included in the key).

MATERIALS AND METHODS

This study is based on study of over 1200 herbarium specimens from CAN, DAO, UBC, US and V, and observations made in the field from 2003–2007. The morphological descriptions are new and are based mostly on study of herbarium specimens collected in British Columbia. For a subset of introduced species for which there are not a lot of collections, Eurasian specimens at CAN were also used to generate the descriptions. Nomenclatural information was compiled through study of the primary literature and numerous secondary sources, including Pavlick (1995) and Pavlick et al. (2003). I have not attempted to account for all of the names that have been applied to the introduced taxa in their native European ranges (i.e., species of B. sects. *Bromus* and *Genea*); these names are rarely used in the North American literature. Information on common names (in English and French) was obtained through internet searches and from information presented by Darbyshire (2003). Data on geographical distribution, elevation and habitat are based on herbarium specimen label data and personal field observations. Where not available on specimen labels, geographical information was obtained from the Geographical Names of Canada website (http://geonames.nrcan.gc.ca/index_e.php, accessed 2007). Maps were produced in ArcView (Environmental Systems Research). All illustrations were prepared by Dr. Cynthia T. Roché, published originally in Flora of North America volume 24 (Barkworth et al. 2007); they are used here with permission.

TAXONOMIC TREATMENT

Bromus L., Sp. Pl. 1:76. 1753. Type: *Bromus secalinus* L. (conserved type: LINN 93.1, see Jarvis, Taxon 41:559. 1992, and Taxon 44:611–612. 1995).

Plants annual or perennial; usually caespitose, occasionally rhizomatous. Culms 7–172 cm tall, one to several per plant. Leaf sheaths closed for most of their length, glabrous or variously pubescent; auricles present or absent; ligules membranous, to 7 mm long; blades flat, abaxial and adaxial surfaces glabrous or variously pubescent. Inflorescences panicles, sometimes racemose, occasionally reduced to a single spikelet, open to dense, erect to nodding. Spikelets 1.3–8 cm long, terete or compressed dorsiventrally to laterally, disarticulation above the glumes and below the lemmas. Glumes unequal, shorter than the adjacent lemma, glabrous or variously pubescent, acute, sometimes mucronate; lower glumes 1–7(9)-veined; upper glumes 3–9(11)-veined. Lemmas rounded to keeled, glabrous or variously pubescent, with a single ±terminal or subterminal awn, occasionally unawned; paleas shorter than lemmas, usually variously ciliate on the keels. Styles 2, inserted laterally on a bilabiate appendage of the ovary. Anthers 2–3. Base chromosome number, $x = 7$.

Etymology.—The name *Bromus* is derived from the Greek *bromos*, which means 'oats'; *bromos* is derived from *broma*, an ancient Greek word for food (Wagnon 1952; Pavlick & Anderton 2007).

KEY TO THE SPECIES OF *BROMUS* SECTIONS *BROMUS*, *BROMOPSIS* AND *GENEA* IN BRITISH COLUMBIA

1. Spikelets laterally compressed; lemmas laterally compressed and strongly keeled (B. sect. Ceratochloa, not treated here).
1. Spikelets not laterally compressed; lemmas flattened dorsiventrally, not strongly keeled.
    2. Lemmas narrow, largest lemmas generally < 2 mm wide; lemma apex bidentate, with awn-like to acuminate hyaline teeth 1–5 mm long (B. sect. Genea).
        3. Lemma bodies 18–35 mm long; awns 30–50 mm long; lower glumes 12–26 mm long; upper glumes 18–35 mm long **4. B. diandrus**
        3. Lemma bodies 9–22 mm long; awns < 30 mm long; lower glumes 4–14 mm long; upper glumes 7–21 mm long.
            4. Lemmas 13–22 mm long; awns 15–30 mm long; panicles sparse, with 1(–3) spikelets per branch; branches straight, usually longer than spikelets **16. B. sterilis**
            4. Lemmas 9–13.8 mm long; awns 8–18 mm long; panicles sparse or dense, usually some branches with > 3 spikelets per branch; branches sinuous, longer or shorter than spikelets **17. B. tectorum**
    2. Lemmas broad, largest lemmas generally > 2 mm wide (except in B. vulgaris) and conspicuously flattened across the back; lemma apex entire or bidentate, teeth usually not hyaline, 0–3 mm long, not awn-like or acuminate.
        5. Plants perennial, often with remnants of a previous years' vegetative growth present; lower glumes 1–3-nerved; upper glumes 3–5-nerved (B. sect. Bromopsis).
            6. Plants with rhizomes; longest anthers > 4 mm long.
                7. Awns (3–)4–7.1 mm long; readily decaying basal sheaths reticulate-fibrillose (i.e., thatched in appearance); cilia present on palea keels only along upper 2/3 to upper half; marginal leaf blade hairs robust and conspicuously widened at the base **13. Bromus riparius**
                7. Awns 0–4 mm long; basal sheaths eventually decaying into straight fibers; cilia present on palea keels along lower ¾ to entire length; leaf blades glabrous or pubescent, marginal hairs (if present) not robust and not conspicuously widened at the base.
                    8. Awns absent or up to 3 mm long; lemmas glabrous to variously scabrous or puberulent on lower 1/6 to 1/4 **6. B. inermis**
                    8. Awns 1–4.5(–5) mm long; lemmas with hairs 0.5–0.8 mm long along margins and midvein, or moderately to densely villous throughout **10. B. pumpellianus**
            6. Plants without rhizomes, all anthers < 4 mm long.
                9. Most lower glumes 3-nerved; awns 1.5–3(–4) mm long **9. B. porteri**
                9. Most lower glumes 1-nerved; awns (2–)3–11 mm long.
                    10. Glumes pubescent.
                        11. Mature inflorescences open, 13–19 cm wide; branches broadly spreading, each with (1–)2–5 spikelets; awns 3–6.5(–7) mm long; ligules 2–4 mm long; leaf blades not thin and papery in herbarium material **8. B. pacificus**
                        11. Mature inflorescences narrow, 1–5 cm wide; branches erect, narrowly ascending or drooping, each with 1(–2) spikelets; awns (4–)6–11 mm long; ligules(2–)3–6(–7) mm long; leaf blades thin and papery in herbarium material **18. B. vulgaris**
                    10. Glumes glabrous.
                        12. Ligules (2–)3–6(–7) mm long; awns (4–)6–11 mm long; larger lemmas ≤ 2 mm wide; leaf blades thin and papery in herbarium material **18. B. vulgaris**
                        12. Ligules 0.5–3 mm long; awns 4–7(–9) mm long; larger lemmas generally > 2 mm wide; leaf blades not thin and papery in herbarium material.
                            13. Lemma backs glabrous or sparsely puberulent with hairs to 0.1 mm long, margins pubescent with hairs 0.5–1.3 mm long; upper glumes 6.5–9.5 mm long; lower glumes 5–7.5 mm long; anthers 0.9–1.6 mm long; basal leaf sheaths glabrous or sparsely to densely pubescent with soft and wavy hairs; upper blades with pilose adaxial surfaces; upper nodes usually pubescent **2. B. ciliatus**
                            13. Lemma backs sparsely to densely pubescent with hairs > 0.1 mm long; upper glumes (8–)9.5–11.5(–14.5) mm long; lower glumes 7–9.5 mm long; anthers (1.2–)1.6–2.7(–3.4) mm long; basal leaf sheaths glabrous or sparsely to densely pubescent with stiff hairs; upper blades with glabrous adaxial surfaces; upper nodes usually glabrous **12. B. richardsonii**

5. Plants annual, without remnants of a previous years' vegetative growth present; lower glumes 3–5-nerved; upper glumes 5–9-nerved (B. sect. Bromus).
    14. Lemmas appearing inflated, 3–4 mm wide; awns absent or to 1 mm long; spikelets ovate **1. B. briziformis**
    14. Lemmas not appearing inflated, < 3 mm wide; awns 2–20 mm long; spikelets lanceolate to ovate-lanceolate.
        15. Lemmas with strongly protruding nerves when dry; panicles usually dense **5. B. hordeaceus**
        15. Lemmas smooth, without strongly protruding nerves; panicles ± open.
            16. Awns arising 1.5–5 mm below the apex of the lemma.
                17. Inflorescense usually racemose and appearing one-sided, the branches usually bearing a single spikelet; lemmas with hyaline margins 0.5–0.9 mm wide **15. B. squarrosus**
                17. Inflorescences usually paniculate and not appearing one-sided, at least the lower branches usually bearing > 1 spikelet; lemmas with hyaline margins 0.3–0.5 mm wide **7. B. japonicus**
            16. Awns arising < 1.5 mm below the apex of the lemmas.
                18. Lower leaf sheaths glabrous or with sparse, stiff hairs 0.5–0.6 mm long; spikelets widening substantially by divergence of the florets as the fruit forms, many rachillas becoming visible as the lemma wraps around the caryopses; caryopses U- and V-shaped in cross section **14. B. secalinus**
                18. Lower leaf sheaths densely pubescent with long, soft hairs to 1.2 mm long; spikelets not widening substantially as the fruit forms, lemmas continuing to obscure most rachillas; caryopses flat or crescent shaped in cross section.
                    19. Panicles narrow, < 2.5 cm wide; inflorescence branches < 4 cm (as measured from node to apex of the terminal floret); 1 spikelet per branch; most larger spikelets < 22 mm long (including awns); lemmas 6.5–9.5 mm long **11. B. racemosus**
                    19. Panicles broad and spreading, > 2.5 cm wide; longest inflorescence branches > 4 cm (as measured from node to apex of the terminal floret); 1–3 spikelets per branch; larger spikelets > 22 mm long (including awns); lemmas 7.5–11 mm long **3. B. commutatus**

1. Bromus briziformis Fisch. & C.A. Mey., Index Sem. (St. Petersburg) 3:30. 1837. (**Figs. 2A–E, 3A**). Type: IRAN: Tahlysh, in locis aridis montosis prope pag. Limar, 1830, *C. Meyer s.n.* (holotype: LE).

Annual; rhizomes absent; plants 17–70 cm tall. Culms 1–2 mm wide at base, smooth; nodes 2, brown-black, pubescent, hairs to 0.2 mm long. Leaf sheaths closed for most of their length, densely pilose with soft hairs to 0.6 mm; auricles absent; ligules 0.5–2 mm long, membranous, glabrous, erose; blades 5.5–10.2 cm long, 1.5–5 mm wide, abaxial surface densely pubescent with short, stiff hairs 0.1–0.3 mm long or densely pilose with long, soft hairs to 1.2 mm long, adaxial surface densely pilose with long, soft hairs to 1.2 mm long, margins smooth or serrulate. Panicles 5–11.5 cm long, 2–6 mm wide, open, lax and somewhat sparse, racemose, often appearing one-sided (secund); branches usually longer than spikelets, scabrous, 1(–2) spikelets per branch, lowest inflorescence node with 1–3 branches. Spikelets 1.8–2.5 cm long, ovate, rachillas not visible at maturity, florets 7–18. Glumes subequal, glabrous; lower glumes 4.6–6 mm long, 3–5-nerved; upper glumes 5–8 mm long, 5–9-nerved. Lemmas 6–9 mm long, 3–4.5 mm wide, 7–9-nerved, nerves not conspicuous, strongly angled near middle, glabrous or puberulent, hyaline margins 0.5–1.1 mm wide at widest point, apex minutely bifid, the cleft 0.1–0.3 mm deep; awn absent or to 1 mm long. Paleas 6.1–6.6 mm long, glabrous. Stamens 3; anthers 0.7–1 mm long, dark brown. $2n = 14$.

Distribution and Habitat.—Introduced. *Bromus briziformis* is native to Eurasia. In British Columbia it is known only from a handful of populations near the Canada/ U.S.A. border (Fig. 3A). It has been collected in the northwestern United States and in a few scattered locations in central and eastern North America (Pavlick & Anderton 2007). Habitats include waste places, roadsides and other disturbed areas. Elevation: 600–914 m.

Common Names.—rattlesnake brome, rattlesnake bromegrass, rattlesnake chess, rattlegrass.

Notes.—*Bromus briziformis* is an annual species that superficially resembles the quaking grasses (*Briza* L.; the introduced *B. major* and *B. minor* are reported from British Columbia), but it is easily distinguished

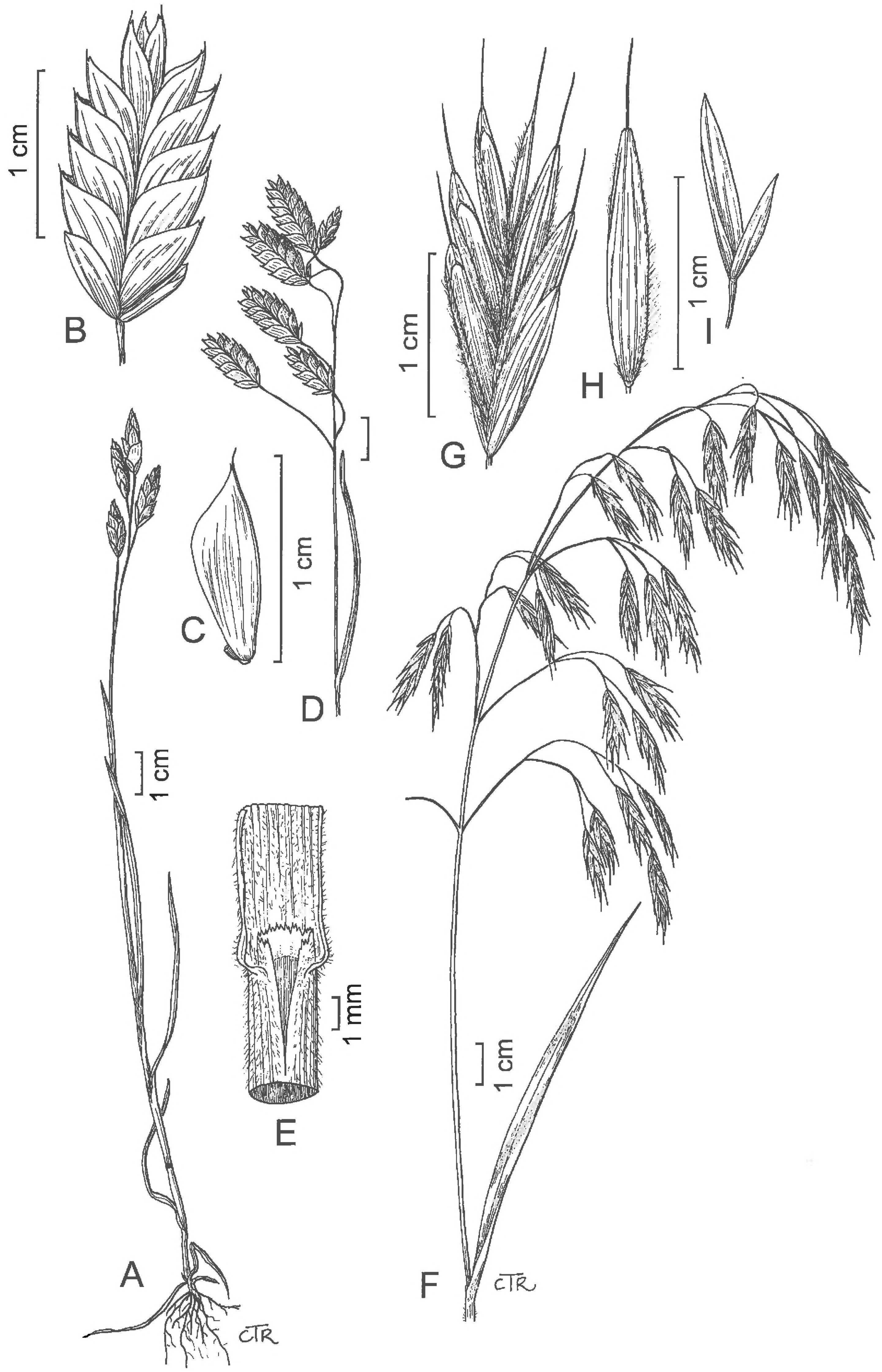

Fig. 2. *Bromus briziformis.* **A.** Habit. **B.** Spikelet. **C.** Lemma. **D.** Inflorescence. **E.** Ligule. *Bromus ciliatus.* **F.** Inflorescence. **G.** Spikelet. **H.** Lemma. **I.** Glumes.

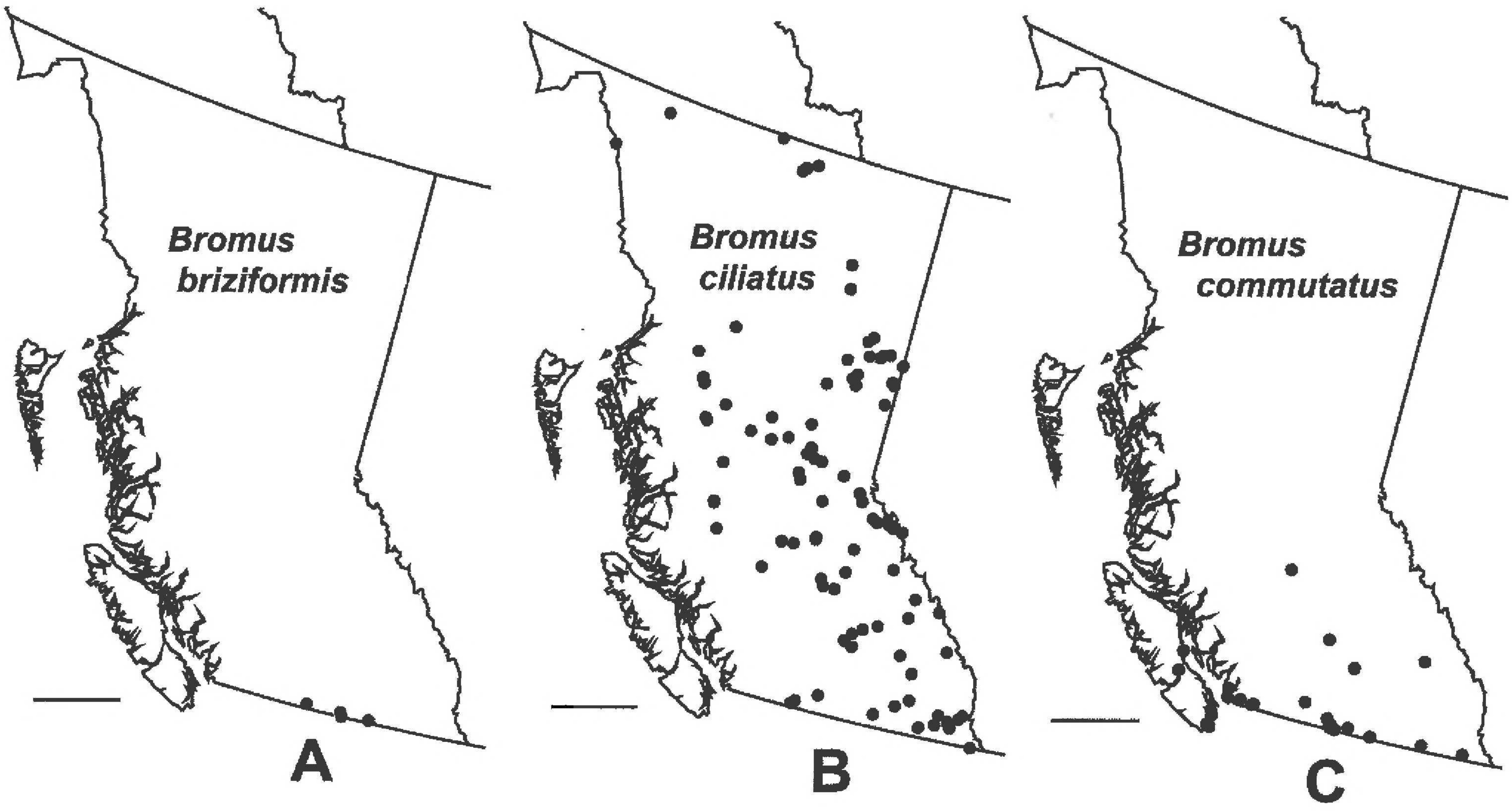

Fig. 3. Geographic distribution in British Columbia. A. *Bromus briziformis*. B. *Bromus ciliatus*. C. *Bromus commutatus*. Scale bars = 200 km.

from species of *Briza* by its closed leaf sheath. It is easily distinguished from all other *Bromus* species on the basis of its wide lemmas.

Representative Specimens Examined. **CANADA. British Columbia:** near International Boundary between Kettle and Columbia rivers, 10 Jun 1902, *J.M. Macoun 63326* (US); Spotted Lake, ca. 2.5 km W of Osoyoos Lake, 12 Jun 1991, *Douglas 12535* (UBC, V); 2.3 km E of Granby River, 500 m N of Sandy Creek Forest Service Road, about 5 km due N of Grand Forks, 2700 ft, 15 Jun 1996, *F. Lomer 96-60* (UBC, V); 400 meters E of Charbonneau Creek, 200 m N of Pend d'Oreille Road, about 3.5 km E of 7 Mile Dam, 20 km SE of Trail, 12 Jun 1996, *F. Lomer 96-44* (UBC).

2. Bromus ciliatus L., Sp. Pl. 1:76–77. 1753. (**Figs. 2F–I, 3B**). *Bromus inermis* var. *ciliata* (L.) Trautv., Acta Horti Petrop. 5:135. 1877. *Bromus purgans* var. *ciliatus* (L.) Kuntze, Revis. Gen. Pl. 2:763. 1891. *Forasaccus ciliatus* (L.) Lunell, Amer. Midl. Naturalist 4:225. 1915. *Bromus ciliatus* var. *genuinus* Fernald, Rhodora 32:70. 1930. *Zerna ciliata* (L.) Henrard, Blumea 4:498. 1941. *Bromopsis ciliata* (L.) Holub, Folia Geobot. Phytotax. 8:167. 1973. Type: U.S.A. New York: Essex Co., Huntington Wildlife Forest Station, Newcomb, sand pit E of Ranger Station, 1600 ft, 23 Jul 1939, *H.F. Heady 768* (neotype: DAO-53967, designated by McNeill, Taxon 25:613. 1976; isoneotype: US).

Bromus canadensis Michx., Fl. Bor.-Amer. 1:65. 1803. *Bromus hookeri* var. *canadensis* (Michx.) E. Fourn., Mexic. Pl. 2:128. 1886. *Zerna canadensis* (Michx.) Tzvelev, Novosti Sist. Vyss. Rast. 7:54. 1970 [1971]. *Bromopsis canadensis* (Michx.) Holub, Folia Geobot. Phytotax. 8:167. 1973. Type: CANADA: Lac St. Jean, *Michaux s.n.* (holotype: P; isotype: US-A0865520, fragment ex P, photostat!).

Bromus purgans var. *pallidus* Hook., Fl-Bor. Amer. 2:252. 1840. *Bromus richardsonii* var. *pallidus* (Hook.) Shear, Bull. Div. Agrostol., U.S.D.A. 23:34. 1900. Type: CANADA: Saskatchewan to the Rocky Mountains, *Drummond s.n.* (holotype: K; isotype: US-A865461, fragment).

Bromus ciliatus f. *denudatus* Wiegand, Rhodora 24:91. 1922. *Bromus ciliatus* var. *denudatus* (Wiegand) Fernald, Rhodora 28:20. 1926. *Bromus ciliatis* subv. *denudatus* (Wiegand) Farw., Amer. Midl. Naturalist 10:203. 1927. Type: U.S.A. Massachusetts: Ashfield, 3 Aug 1909, *E.F. Williams s.n.* (holotype: GH; isotype: US-865527!, fragment).

Bromus ciliatus var. *intonsus* Fernald, Rhodora 32:70. 1930. *Bromus ciliatus* f. *intonsus* (Fernald) F. Seym., Fl. N. England 60. 1969. Type: U.S.A. Massachusetts: Ashfield, 4 Aug 1909, *E.F. Williams s.n.* (holotype: GH; isotype: US-865526!, fragment ex GH).

Bromus dudleyi Fernald, Rhodora 32:63, pl. 196. 1930. Type: CANADA. Newfoundland: bushy swale along Deer Brook, Bonne Bay, 26 Aug 1929, *M.L. Fernald, Long & Fogg 1223* (holotype: GH; isotype: US-865487!, fragment ex GH).

Perennial; rhizomes absent; plants 55–149 cm tall. Culms 1.2–4 mm wide at base, smooth; nodes 4–6, brown, pubescent, hairs 0.2–0.5 mm long. Leaf sheaths closed for most of their length, glabrous or sparsely to densely pubescent with soft, wavy hairs to 1.6 mm long; auricles absent; ligules 0.5–1.6 mm long, membranous, glabrous or minutely pubescent, erose; blades 10–27 cm long, 4–12 mm wide, adaxial surfaces pubescent with soft, wavy hairs 0.3–1.3 mm long, abaxial surfaces glabrous, margins smooth or serrulate. Panicles 8–21 cm long, 3.5–10.5 cm wide, open; branches ascending to spreading or drooping, shorter or longer than spikelet, glabrous or scabrous, 1–4 spikelets per branch, lowest inflorescence node with 1–5 branches. Spikelets 2.2–3 cm long (including awns); florets 4–9. Glumes subequal, lanceolate, glabrous, keels ± scabrous; lower glumes 5–7.5 mm long, 1(–3)-nerved; upper glumes 6.5–9.5 mm long, 3(–5)-nerved, sometimes mucronate with mucros to 0.2 mm long. Lemmas 8–14 mm long, 1–2.5 mm wide, 7-nerved, pubescent along margins with hairs 0.5–1.3 mm long, hairs sometimes restriced to lower 1/3, backs glabrous or puberulent with hairs to 0.1 mm long, apex entire or minutely bifid, the cleft to 0.2 mm deep; awns (1–)2–6.5 mm long, arising 0–0.2 mm below lemma apex, straight, antrorsely scabrous. Paleas 7.4–9.2 mm long, shorter than lemmas, keels ciliate, cilia to 0.5 mm long. Stamens 3; anthers 1–1.7 mm long, dark brown. $2n = 14$.

Distribution and Habitat.—Native. *Bromus ciliatus* is the widest-ranging native *B.* sect *Bromopsis* species in North America. It occurs across the continent, absent only in south-central and south-eastern U.S.A. (Pavlick & Anderton 2007). *Bromus ciliatus* occurs throughout British Columbia, mostly east of the coastal mountain ranges (Fig. 3B). Its distribution is sympatric with that of *B. richardsonii*, but *B. ciliatus* generally occurs at lower elevations (Peterson et al. 2002). *Bromus ciliatus* occurs in a wide range of habitats, including wet ditches, roadsides, boggy areas, dry terraces, moist woodlands, forest openings, stream banks, rocky flats and grassy areas. Elevation: 396–1554 m.

Common Names.—English: fringed brome; French: brome cilié.

Notes.—*Bromus ciliatus* and *B. richardsonii* have been variously treated as the same or separate taxa (see comments under *B. richardsonii*). Peterson et al. (2002) demonstrated that these taxa are morphologically and genetically distinct and appropriately recognized at the species level. Because *B. ciliatus* occurs in a variety of habitats, there is interest, particularly in western Canada, for developing ecological cultivars for re-seeding disturbed areas and clearcuts (see May et al. 1998, 1999; Fu et al. 2005). Fu et al. (2005) used AFLP data to examine molecular variation within and among *B. ciliatus* populations across Canada and found high among-population variation and low within-population variation.

Representative Specimens Examined. **CANADA. British Columbia:** Yellowhead Pass, Rocky Mtns, 20 Jul 1848, *W.S. Spreadborough 21012* (US); Sand Creek, Kootenay Valley, 23 Jul 1883, *Dawson s.n.* (CAN); Six-mile Creek, Selkirk Mtns, 8 Aug 1885, *J. Macoun 72994* (US); Selkirk Mountains, Six-mile Creek, 8 Aug 1885, *J. Macoun 72997* (CAN); Sicamous, 3 Jul 1889, *J. Macoun 30013* (CAN); McLennnan River headwaters of Columbia River, 27 Jul 1898, *W.S. Spreadborough s.n.* (CAN); Armstrong, 27 Aug 1904, *E. Wilson 415* (UBC); Armstrong, 31 Aug 1904, *E. Wilson 421* (UBC); Salmon Arm, 15 Aug 1911, *M.O. Malte s.n.* (CAN); Salmon Arm, 15 Aug 1911, *M.O. Malte s.n.* (DAO); McBride, 2360 ft, Jun-Jul 1914, *J.A. Walker s.n.* (UBC); Hazelton, 17 Jul 1917, *J.M. Macoun 93974* (CAN, DAO, V); Vanderhoof, 5 Aug 1919, *J.M. Macoun s.n.* (CAN); Vanderhoof, 6 Aug 1919, *J.M. Macoun s.n.* (CAN, V); Pouce Coupe, 15 Jul 1921, *M.O. Malte s.n.* (CAN, DAO); Fraser Lake, 2222 ft, Aug 1922, *Mackenzie s.n.* (V); Vanderhoof, 18 Jul 1929, *S.G. Preston s.n.* (UBC); Dawson Creek, 3 Sep 1934, *H. Groh s.n.* (DAO); Smithers, Jul 1938, *J.D. Menzies s.n.* (UBC, V); Tetana Lake, 28 Jul 1938, *T. Fletcher s.n.* (V); Wardner, Aug 1939, *W.R. Foster s.n.* (UBC); Nelson, Apex, 10 Jul 1940, *J.W. Eastham 7766* (DAO, UBC); near Kinbasket Lake, 70 mi W of Golden, 21 Jul 1941, *J.W. Eastham 9296* (DAO); Kinbasket Lake, Big Bend Highway, 21 Jul 1941, *J.W. Eastham s.n.* (DAO, UBC, V); near Griffin Lake, between Revelstoke and Sicamous, 23 Jul 1941, *J.W. Eastham 9353* (DAO, UBC); Griffin Lake, 27 Jul 1941, *J.W. Eastham s.n.* (V); Alaska Highway, Minaker River, mile 157, 19 Jun 1943, *C.H.D. Clarke 4* (CAN); old Cranbrook-Moyie road, 6 Aug 1943, *J.W. Eastham s.n.* (UBC, V); vicinity of Buckinghorse River, 31 Aug 1943, *H.M. Raup & D.S. Correll 11598* (UBC); S of Hazelton, 12 Jul 1944, *J.W. Eastham s.n.* (UBC); Woodpecker at Meadow Creek, 18 Jul 1944, *J.W. Eastham s.n.* (V); Cariboo, Horsefly district, 31 Jul 1944, *J.W. Eastham s.n.* (UBC, V); Anahim Lake, Chilcotin, Aug 1944, *C.F. Cornwall 12362* (CAN, DAO, UBC, V); Smithers, 26 Jul 1946, *J.W. Eastham s.n.* (UBC); Smithers, 26 Jul 1946, *J.W. Eastham 14838* (DAO); Fort St. John, 4 Sep 1946, *H. Groh 3049* (DAO); Liard Hot Springs, 1 Aug 1946, *J.P. Anderson 10362* (CAN); vicinity of hot spring near lower crossing of Liard River, 25 Aug 1948, *H.M. Raup & D.S. Correll 11519* (CAN, UBC); Deka Lake, 4 Sep 1953, *V.C. Brink s.n.* (UBC); 1.5 mi S of Hixon along highway from Prince George to Quesnel, 10 Aug 1954, *J.A. Calder, D.B.O. Savile & J.M. Ferguson 14341* (DAO); 7 mi SW of Telkwa along Goathorn Creek, Smithers area, 31 Aug 1954, *J.A. Calder, D.B.O. Savile & J.M. Ferguson 15271* (DAO); 1 mi W of Fairy Creek, Fernie, 3500 ft, 31 Jul 1956, *F.J. Hermann 13014* (US); Kootenay National Park, McCleod Meadows, 2 mi S along Nixon Creek, 3700 ft, 9 Aug 1956, *F.J. Hermann 13227* (US); 5.5 mi E of Bridge Lake P.O. on road to Littlefort, 11 Aug 1956, *J.A. Calder, J. A. Parmelee & R.L. Taylor20007* (DAO); 1 mi W of McClinchy Creek bridge between Kleena Kleene and Anahim Lake, W of Williams Lake, 15 Aug 1956, *J.A. Calder, J. A. Parmelee & R.L. Taylor 20122* (DAO); Sage Creek Lodge, Flathead, 5100 ft, 22 Jul 1957, *J. Davidson s.n.* (DAO, UBC, V); Help Lake area 24 mi NW of Donald, 8 Aug 1958, *R.L. Taylor & D.H. Ferguson 3654* (DAO); Liard Hot Springs, ca.1300 ft, 28 Jun 1960, *A.E. Porsild & R.T. Porsild 21954* (CAN); Liard Hotsprings, 27 Jul 1960, *J.A. Calder & I. Kukkonen 27556* (DAO); Wells Gray Provincial Park, outside the park boundary at the S entrance, near Hemp Creek Ranger Station, S Cariboo Mountains, 9 Jul 1961, *L. Ahti & T. Ahti 6877* (DAO); point of land overlooking Peace River Valley, 25 mi W of Fort St. John, last week of Jul 1961, *D. Kyanston & M.S. Dhaliwal 7* (DAO); Willow River, 20 mi S of Giscome, 10 Aug 1963, *S. Eis & A. Auclair 451* (CAN); 4 mi N of Davie Lake, ca. 50 mi N of Prince George, 16 Aug 1963, *A. Auclair 484* (DAO); Prince George District, along the road to Davie Lake, 2000–2400 ft, 17 Aug 1963, *A. Auclair & S. Eis s.n.* (DAO); Portage Mtn dam, 25 Jul 1965, *A. F. Szczawinski 7/65* (V); N of Williams Lake, 11 Jul 1967, *C. Beil 67-7-11-14* (UBC); Murray Range NE of Pine Pass, Cariboo District, 19 Jul 1971, *R. Revel s.n.* (UBC); Glacier National Park, Mountain Creek Campground, 29 Jul 1972, *E. Haber & M.J. Shchepanek 1698* (CAN); Manning Park, Orchid meadow, 2 mi E of Ranger Station, 31 Jul 1973, *C. C. Chuang 870, 880* (CAN); Taspai Creek, ca. 27 mi ESE of Prince George, 2550 ft, 5 Aug 1974, *V.J. Krajina, J. Pojar & C. Parsons s.n.* (UBC); Jim Meadow, Chilcotin, 24 Jul 1979, *C. Selby & A. Roberts s.n.* (UBC); near Cooper Creek, 1340 m, 20 Aug 1980, *L.E. Pavlick 80-560* (V); Cariboo District, near Ratdam, N of Horsefly, 16 Jul 1982, *S.G. Aiken & S.J. Darbyshire 2350* (DAO); Upper Teslin River, 8 Aug 1983, *C. McEwen 6207* (DAO); Chilcotin area, Cooper Creek, junction of road to Lake Mons and Sky ranch, 14 Sep 1993, *J. Cayouette 7615* (DAO); Peace River Land District, 6 km N of Chetwind, 10 Sep 1998, *J. Cayouette 8494* (DAO); Cariboo Land District, Perry Road, S of Shelley, 11 Sep 1998, *J. Cayouette 8495* (DAO); Cariboo Land District, Dome Creek, road 16, 11 Sep 1998, *J. Cayouette 8497* (DAO); Mount Robson Prov. Park, Redpass, close to Fraser River, 11 Sep 1998, *J. Cayouette 8499* (DAO); Willow Creek Rest Area on Hwy 16, S of Prince George, 6 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18446* (CAN, US); Liard River Hot Springs Provincial Park, 20 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18659* (CAN, UBC).

3. Bromus commutatus Schrad., Fl. Germ. 353. 1806. **(Figs. 3C, 4A–D)**. *Brachypodium commutatum* (Schrad.) P. Beauv., Ess. Agrostogr. 101, 155. 1812. *Bromus mutabilis* var. *commutatus* (Schrad.) F.W. Schultz, Flora 32:234. 1849. *Serrafulcus commutatus* (Schrad.) Bab., Man. Brit. Bot. 1:374. 1843. *Bromus racemosus* var. *commutatus* (Schrad.) Coss. & T. Durand, Expl. Sci. Algérie 2:165. 1855. *Bromus mollis* var. *commutatus* (Schrad.) Sanio, Verh. Bot. Vereins Prov. Brandenburg 23:Abh. (3)31. 1882. *Serrafulcus racemosus* var. *commutatus* (Schrad.) Husn., Graminees 72. 1899. *Forasaccus commutatus* (Schrad.) Bubani, Fl. Pyren. 4:387. 1901. *Bromus racemosus* subsp. *commutatus* (Schrad.) Tourlet, Cat. Pl. Vasc. Indre-et-Loire 588. 1908. *Bromus hordeaceus* var. *commutatus* (Schrad.) Fiori, Nuov. Fl. Italia 1:149. 1923. *Bromus secalinus* subsp. *commutatus* (Schrad.) Lloret, Collect. Bot. (Barcelona) 22:151. 1993. Type: GERMANY: Inter segetes, ad vias, sepes, alibique.

Bromus secalinus var. *gladewitzii* Farw., Amer. Midl. Naturalist 10:24. 1926. Type: U.S.A. Michigan: Edgewater Park, *Farwell & Gladewitz 7434* (isotype: MICH-1108616).

Annual; rhizomes absent; plants 20–100 cm tall. Culms 1.5–3 mm wide at base, smooth; nodes 3–5, yellow-brown, densely pubescent with stiff hairs 0.2–1 mm long. Leaf sheaths closed for most of their length, densely pubescent, hairs soft and wavy to 1.2 mm long; auricles absent; ligules 1–3 mm long, membranous, glabrous or pubescent, erose; blades 8–16 cm long, 2–4 mm wide, adaxial surface densely pubescent with long, stiff hairs to 2.5 mm long, abaxial surface pubescent with dense hairs 0.1–0.5 mm long, margins smooth or serrulate. Panicles 5.5–17 cm long, 2.5–8 cm wide, open, longest lower branch > 4 cm long (as measured from node to apex of terminal floret including awn); branches erect to ascending, sometimes secund, scabrous to pubescent, 1–3 spikelets per branch, lowest inflorescence node with 1–3 branches. Spikelets 2–3 cm long (including awns), ovate-lanceolate, rachillas sometimes visible at maturity, florets 6–12. Glumes slightly subequal, smooth or scabrous, keels occasionally serrulate distally; lower glumes 5.5–8.2 mm long, 5-nerved; upper glumes 6.9–8.5 mm long, 7(9)-nerved. Lemmas 7–11 mm long, 1.5–2 mm wide, 7–9-nerved, nerves visible but not conspicuously raised, backs glabrous or scabrous to puberulent, margins often bluntly angled, apex entire or minutely bifid, the cleft 0.1–0.2 mm deep; awns 5–8.5 mm long, arising < 1.5 mm below lemma apex, straight or minutely divaricate, antrorsely scabrous, awn of lowest floret shorter than others. Paleas 6-10 mm long, shorter than lemmas, backs glabrous, keels ciliate, cilia to 0.3 mm long. Stamens 2; anthers 0.5–2.5 mm long, dark brown. $2n$ = 14, 28, 56.

Distribution and Habitat.—Introduced. *Bromus commutatus* is native to Europe. It is common in eastern and western North America and occurs in scattered locations across the United States Great Plains (Pavlick & Anderton 2007). In British Columbia, *B. commutatus* occurs in the southern portion of the province (Fig. 3C). Habitats include waste places, fields and grasslands. Elevation: 0–967 m.

Common Names.—English: hairy brome, hairy chess, meadow brome, upright chess; French: brome variable, brome confondu.

Notes.—*Bromus commutatus* and *B. racemosus* are morphologically similar species that are often notoriously difficult to distinguish. They are both native to Europe, but now much more widely distributed. Hitchcock & Chase (1951:49) noted that these taxa are "differentiated only by arbitrary characters." In his classification of subgenus *Bromus* (=*B.* sect. *Bromus*), Scholz (1970) placed *B. commutatus* and *B. racemosus* in different series, and many authors recognize them as separate species (e.g., Clapham et al. 1987; Conert 1997; Smith

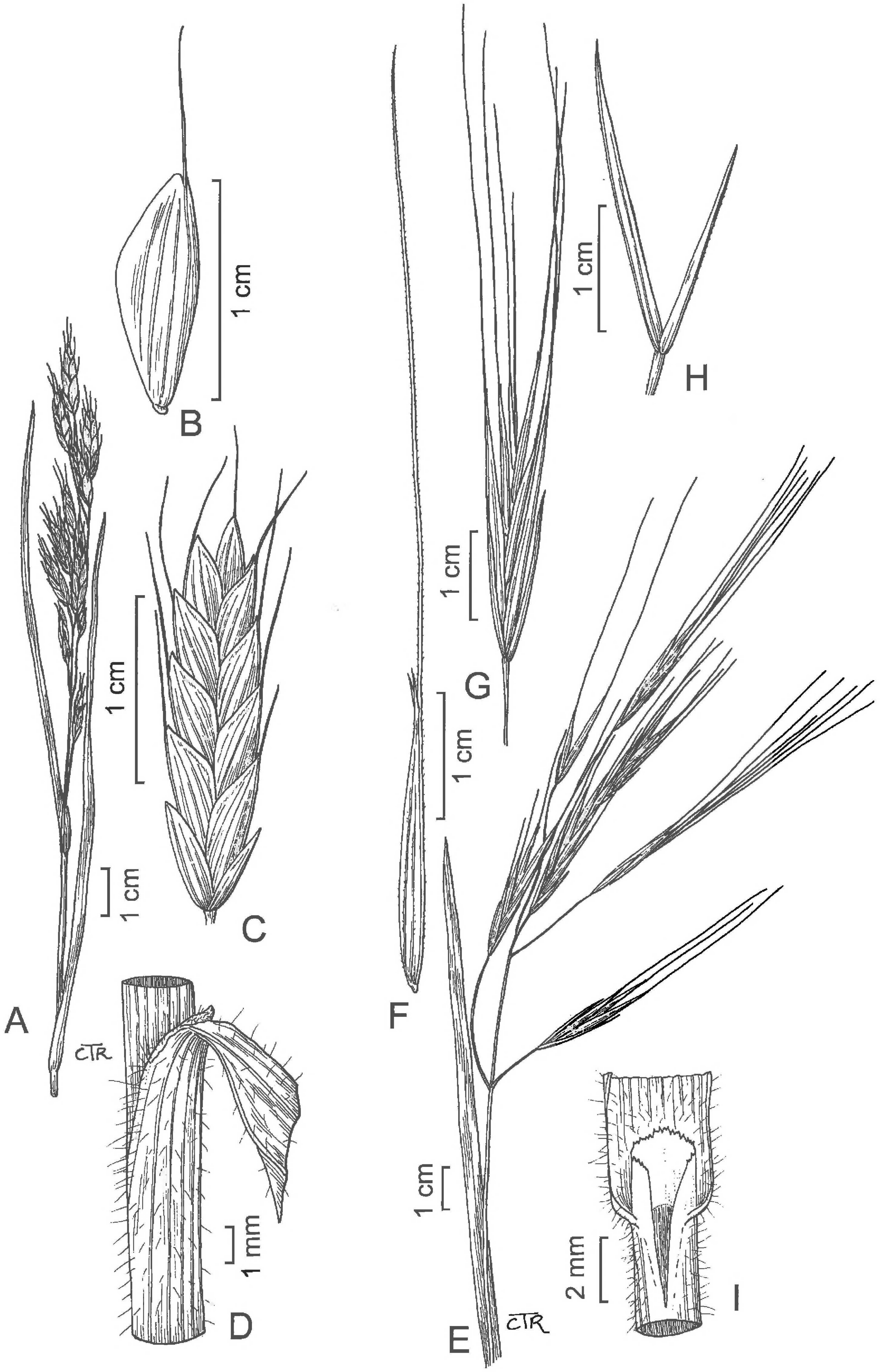

Fig. 4. *Bromus commutatus*. **A.** Inflorescence. **B.** Lemma. **C.** Spikelet. **D.** Ligule. *Bromus diandrus*. **E.** Inflorescence. **F.** Floret. **G.** Spikelet. **H.** Glumes. **I.** Ligule.

1980, 1985; Stace 1997; Douglas et al. 2001; Pavlick & Anderton 2007; Saarela & Peterson in press), but others have treated *B. commutatus* as a subspecies of *B. racemosus* (e.g., Shear 1900; Acedo & Llamas 1999; Lauber & Wagner 1996; Meijden 1996) or at least suggested that this treatment might be appropriate (e.g., Pavlick 1995; Planchuelo & Peterson 2000). Some workers lump these taxa and recognize only a single, variable species (e.g., Liang et al. 2006). Acedo & Llamas (1999) noted substantial morphological variation among these taxa in the Iberian Peninsula, and indicated that environmental conditions influence plant and inflorescence size.

In most treatments, *B. commutatus* is circumscribed as having longer lemmas (8–11 mm vs. 6.5–8 mm in *B. racemosus*), broadly angled lemma margins (vs. rounded) and shorter anthers (but measurements in earlier keys vary substantially) [reviewed by Spalton 2002]. Additionally, *B. commutatus* is generally considered to have more open panicles with longer branches that sometimes have more than one spikelet (vs. less open panicles with shorter branches usually with a single spikelet), but these characters have not often been used in keys. Spalton (2002) conducted a morphological analysis of *B. racemosus*, *B. commutatus* and the morphologically similar species *B. secalinus*, based on material from throughout their native ranges. He demonstrated substantial overlap in characters traditionally used to distinguish *B. racemosus* and *B. commutatus* (e.g., lemma length) and found that the single best diagnostic character to distinguish the taxa is the length of the lowest panicle branches (including the terminal spikelet) (i.e., > 4 cm long in *B. commutatus* vs. < 4 cm long in *B. racemosus*). Consequently, Spalton's (2002) circumscriptions of *B. commutatus* and *B. racemosus* are slightly different from those employed by earlier authors, but his work is also the most comprehensive study of variation in the complex. Spalton (2002) concluded that *B. commutatus* is distinguished by its larger, more open and often branched inflorescences and larger spikelets, and *B. racemosus* is distinguished by its narrower, unbranched inflorescences and smaller spikelets. Using these characters, most British Columbia individuals can be readily placed into one of these two taxa. My observations of material from British Columbia indicate that plants with longer inflorescence branches are generally more robust, usually with some branches that have more than one spikelet and larger spikelets. I follow Spalton's circumscription here and recognize *B. commutatus* and *B. racemosus* at the species level, as in most recent treatments of these taxa in North America and Europe. I have observed mixed populations of *B. commutatus* and *B. racemosus* in British Columbia near Princeton [*Saarela, Sears & Maze 586A* (CAN, UBC), *586B* (CAN)] and Elko [*Saarela 405A* (CAN, UBC), *405B* (CAN)]. A comprehensive genetic study of this complex, ideally based on material from throughout their native ranges, would contribute to clarifying the natural boundaries between these taxa.

Representative Specimens Examined. **CANADA. British Columbia:** Cedar Hill, Vancouver Island, 16 Jun 1887, *Macoun 29982* (CAN); vicinity of Victoria, 6 Jun 1908, *J. Macoun 77852* (CAN, US); Saltspring Island, 24 May 1914, *J.M. Macoun 90094* (CAN, US); Comox, Vancouver Island, 19 Jun 1915, *J.M. Macoun 93968* (CAN); Vernon, 27 Jun 1917, *E.M. Warren s.n.* (UBC); Langley Prairie, 30 May 1931, *H. Groh s.n.* (DAO); S bank of Fraser River, N Ladner, 7.5.1932, *E.P. Hume s.n.* (UBC); Sumas Recreation, 13 May 1935, *D.W. Thompson s.n.* (UBC); Victoria, 2 Jun 1938, *J.W. Eastham s.n.* (UBC); Creston, 21 Jun 1938, *J.W. Eastham s.n.* (UBC); The Gorge, Victoria, 11 Jun 1939, *J.W. Eastham s.n.* (DAO, UBC); Sproat River Falls, 1 Jul 1939, *J.W. Eastham s.n.* (UBC); Arrowhead, 19 Jul 1939, *H. Groh 210* (DAO); S of Kamloops, 24 Jul 1939, *H. Groh 29.5* (DAO); Christine Lake, 16 Jun 1940, *J.W. Eastham s.n.* (UBC); Thetis Lake, 27 May 1941, *J.W. Eastham s.n.* (UBC); Cariboo District, Alkali Lake, 640 m, 18 Jul 1982, *S.G. Aiken, S.J. Darbyshire & A. Roberts 2396* (DAO); Abbotsford, intersection of Hwys. 1 and 11, along ramp, 29 Jun 1988, *S.J. Darbyshire 3729* (CAN); Great Northern Way near Clarke Drive, Vancouver, 22 Jun 1994, *F. Lomer 94-251* (UBC); Kettle River Campground, 5 km N of jct. 3 and 33 along Hwy 33, 25 Jun 2003, *J.M. Saarela & A. Roe 254* (CAN, UBC); Rocky Mountain Forest District, along Hwy 3, 1.5 km E of Elko, 23 May 2006, *J.M. Saarela 405B* (CAN); 10 km W of Princeton on Hwy 3, 19 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 586B* (CAN); NE of Osoyoos ca. 3 km going up Anarchist Mountain, just before town lookout and just beyond the first switchback, 20 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 644* (CAN, UBC); W of Osoyoos, 1.3 km up Richter Mountain Road, 19 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 631* (CAN, UBC); Fairview Road, ca. 2 km NE from intersection with Lowe Road, Blind Creek Indian Reserve, NE of Cawston, 19 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 619* (CAN, UBC); Spotted Lake, ca. 5km W of Osoyoos, S of Hwy 3, 20 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 679* (CAN).

4. Bromus diandrus Roth, Bot. Abh. Beobacht. 44. 1787. (**Figs. 4E–I, 5A**). *Anisantha diandra* (Roth) Tutin, Fl. British Isles, ed. 2. 1149. 1962. *Anisantha diandra* (Roth) Tutin ex Tzvelev, Bot. Mater. Gerb. Bot. Inst. Acad. Nauk SSSR 22:4. 1963. TYPE: Gr. Bromoides, locustis maximus, lanuginosum, Italicum, Hist. Nat. 261. no. 444 (NEOTYPE: OXF-Scheuchzer herb., designated by Sales, Edinb. J. Bot. 50:8. 1993).

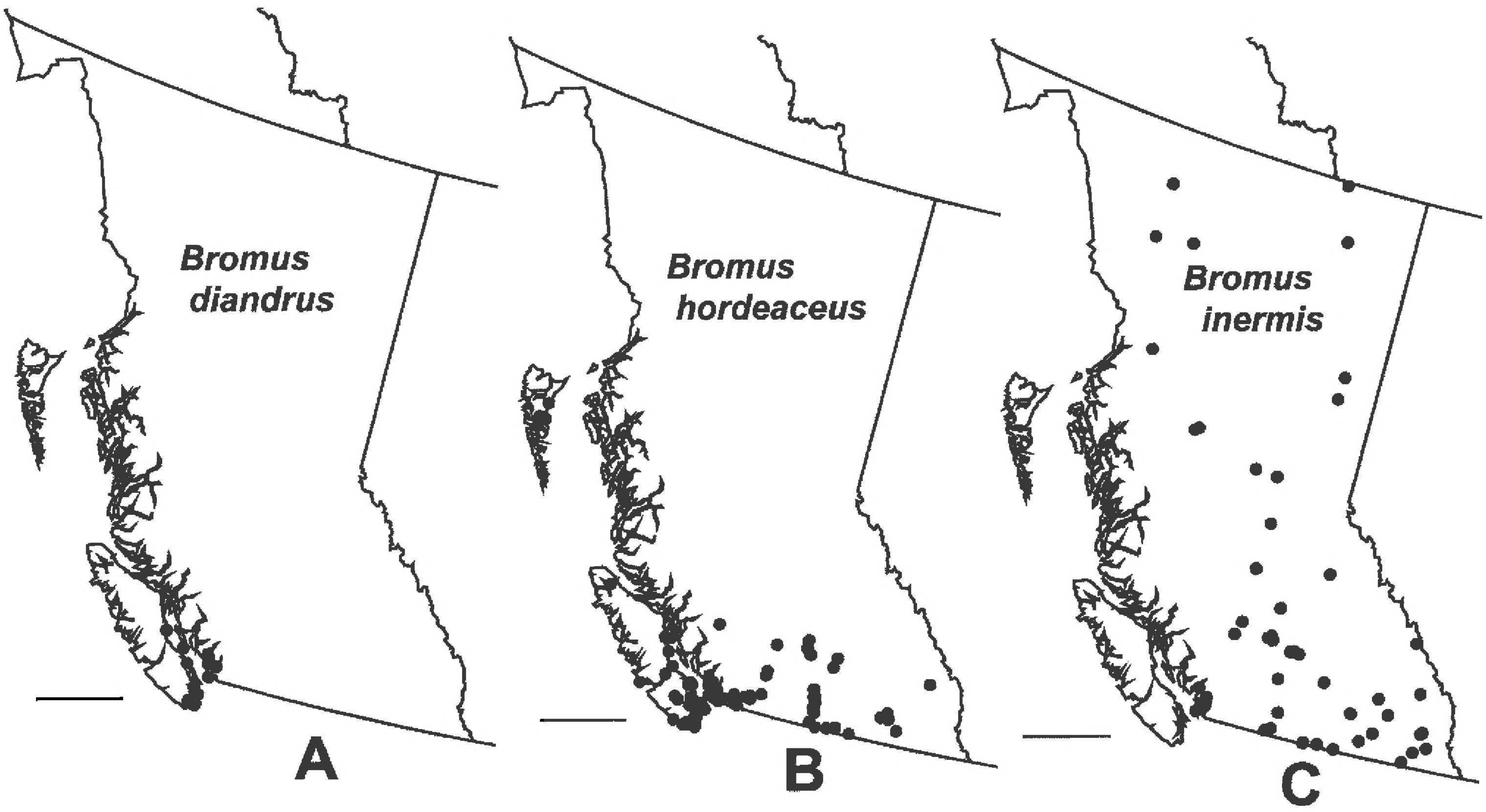

Fig. 5. Geographic distribution in British Columbia. A. *Bromus diandrus*. B. *Bromus hordeaceus*. C. *Bromus inermis*. Scale bars = 200 km.

Bromus rigidus Roth, Bot. Mag. (Römer & Usteri) 10:21–23. 1790. *Genea rigida* (Roth) Dumort., Étude Michelaria 30. 1868. *Bromus madritensis* var. *rigidus* (Roth) Bab. ex Syme, Engl. Bot., ed. 3b. 11:161. 1873. *B. villosus* var. *rigidus* (Roth) Asch. & Graebn., Syn. Mitteleur. Fl. 2:595. 1901. *Anisantha rigida* (Roth) Hyl. Uppsala Univ. Arsskr. 7:32. 1945. *Bromus diandrus* subsp. *rigidus* (Roth) Lainz, Aanl. Inst. Forest. Invest. Exper. 12:49. 1967. *Anisantha diandra* Roth subsp. *rigida* (Roth) Tzvel., Zlaki SSSR. 1:223. 1976. *Bromus diandrus* subsp. *rigidus* (Roth) O. Bolòs, Masalles & Vigo, Collect. Bot. (Barcelona) 17:96. 1987[1988]. *Bromus diandrus* var. *rigidus* (Roth) Sales, Edinb. J. Bot. 50:9. 1993. Type: Habitat in Europa australi (neotype: B-Willd., designated by Sales, Edinb. J. Bot. 50:9–10. 1993).

Annual; rhizomes absent; 15–120 cm tall. Culms 0.8–3 mm wide at base, smooth, sometimes pubescent below panicles; nodes 2–3, blackish brown, glabrous. Leaf sheaths closed for most of their length, pubescent, with short stiff hairs to 0.6 mm long or soft hairs to 2.5 mm long; auricles absent; ligules 2.2–5 mm long, membranous, glabrous, erose-lacerate; blades 3–18 cm long, 2–7 mm wide; adaxial and abaxial surfaces pubescent with long, soft hairs to 1.5 mm long, margins smooth or hairy. Panicles 6–30 cm long, 2–25 cm wide, erect when young, sometimes becoming spreading or nodding at maturity; branches usually shorter than spikelets, scabrous to densely pubescent, usually with one spikelet per branch; lowest inflorescence node with 1–3 branches. Spikelets 6.5–8 cm long (including awns), cuneate, ±compressed dorsiventrally, sometimes spreading at maturity with visible rachillas; florets 5–8. Glumes subequal, linear-lanceolate, glabrous, keels glabrous or serrulate, particularly distally, margins hyaline; lower glumes 12–26 mm long, 1(–3)-nerved; upper glumes 18–35 mm long, 3(–5)-nerved. Lemmas 18–35 mm long, 1–2 mm wide, 7-nerved, lanceolate, backs sparsely to densely scabrous, sometimes with hairs to 1 mm long at apex or along margins, occasionally with a dense tuft of hairs 0.1–0.2 mm long at base, margins hyaline (except at base), smooth or minutely serrulate, keels serrulate, apex bifid, the cleft 2.2–5.2 mm deep; awns 30–50 mm long, arising 3.5–6 mm below lemma apex, straight, antrorsely scabrous. Paleas 13–16 mm long, shorter than lemmas, backs glabrous, keels ciliate, cilia to 0.5 mm long. Stamens 3; anthers 0.5–1.2 mm long, dark brown. $2n$ = 42, 56.

Distribution and Habitat.—Introduced. *Bromus diandrus* is native to Europe. In North America it is common in the west from Washington to California and Texas, with some scattered localities in the southeastern United States (Pavlick & Anderton 2007). In British Columbia the species occurs on southern Vancouver Island and in the Vancouver area (Fig. 5A), where it is distributed in waste places, roadsides, thickets, river banks, sand bars, rocky outcrops, grassy banks and disturbed ground. Elevation: 0–290 m.

Common Names.—ripgut brome, ripgut grass.

Notes.—In British Columbia (Douglas et al. 2001) and elsewhere in western North America, this introduced taxon has previously been treated as *B. rigidus* Roth. Sales (1993) conducted a comprehensive survey of morphological, geographical and ecological variation in the *Bromus diandrus/ rigidus* complex based on material collected throughout its native European range, and recognized these taxa as varieties: *B. diandrus* var. *diandrus* and *B. diandrus* var. *rigidus* (Roth) Sales. However, Sales (1993) noted that the differences between her varieties are very subtle and that it is often very difficult to place specimens into one variety or the other. I therefore treat all British Columbia material as *B. diandrus* s.l., with no recognition of intraspecific taxa, as in the recent *Bromus* treatment for North America by Pavlick and Anderton (2007) and that forthcoming for California (Saarela & Peterson in press). *Bromus diandrus* has the largest spikelet characters (glumes, lemmas, awns) among the three *B.* sect. *Genea* species in British Columbia; consequently, it is straightforward to identify.

Representative Specimens Examined. **CANADA. British Columbia:** near Victoria, Jun 1876, *Dawson 30040* (CAN); Nanaimo, Vancouver Island, 12 Jul 1893, *Macoun 30039* (CAN); Nanaimo, Vancouver Island, 17 Jul 1908, *J. Macoun 76832* (CAN, US); Victoria, 17 Aug 1912, *M.O. Malte 108314* (CAN, DAO); vicinity of Sidney, 20 Jun 1913, *J. Macoun 88538* (CAN); Victoria, 1 Jun 1938, *J.W. Eastham 419c* (UBC); C. N. railway yards, Nanaimo, Vancouver Island, 31 May 1939, *J.W. Eastham s.n.* (DAO); Vancouver Island, Anderson Hill, near Victoria, 65 m, 17 May 1950, *V. Krajina & R.H. Spilsbury 3859* (DAO); Victoria, above McNeil Bay, 60 m, 21 May 1950, *V. Krajina & R.H. Spilsbury 3950* (UBC); Nanaimo, Vancouver Island, 10 m, 12 Jun 1950, *V. Krajina, R.H. Spilsbury & A. Szczawinski 9360* (DAO, UBC); Esquimalt Lagoon, Victoria, 3 May 1962, *J. Spraggs s.n.* (DAO); Esquimalt Lagoon near Victoria, 29 May 1962, *J. Hett s.n.* (DAO [3 sheets]); Victoria and vicinity, Vancouver Island, 10 Jul 1964, *H.J. Scoggan 15431* (CAN); Gonzales Hill, Vancouver Island, 300 ft, 14 May 1965, *B.W. Davies & R.A. Keller 365* (DAO); Smugglers Cove, Ten Mile Point, 10 ft, 19 May 1965, *B.W. Davies 446* (DAO); Goldstream Park, Victoria, 20 Jul 1980, *R. Hainault 8244* (DAO); Vancouver Island, S Saanich District, Saanich Peninsula, Central Saanich Municipality, Island View Beach, Cordova Spit, 2 Jul 1982, *S.G. Aiken, S.J. Darbyshire & L.E. Pavlick 2127* (DAO); Cowichan District, Saltspring Island, Mount Tuam above Cape Keppel, 950 ft, 3 Jul 1982, *S.G. Aiken, S.J. Darbyshire & L.E. Pavlick 2154* (DAO); Goose Spit, Comox, 4 May 1984, *V.C. Brink s.n.* (UBC); Sangster Island, 20 May 1985, *A. Ceska, O. Ceska & M. Ceska s.n.* (UBC); Holland Point, Victoria, 30 Jun 1988, *S.J. Darbyshire 3737* (CAN, DAO); Cadboro Bay, Victoria, 1 Jul 1988, *S.J. Darbyshire 3747* (CAN, DAO); University of British Columbia, Museum of Anthropology, edge of parking lot, 15 May 2006, *J.M. Saarela 332* (CAN, UBC); Horseshoe Bay, Whytecliff Park, 27 May 2006, *J.M. Saarela 509* (CAN, UBC); S end of Tsawassen Drive S, Tsawassen Indian Reserve #0, 28 May 2006, *J.M. Saarela & C. Sears 544* (CAN, UBC); Vancouver Island, Island View Park, S of Hwy 17 between Sidney and Victoria, 4 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 847* (CAN, UBC).

5. Bromus hordeaceus L., Sp. Pl. 1:77. 1753. **(Figs. 5B, 6)**. *Bromus secalinus* var. *hordeaceus* (L.) L., Flora Suecica, ed. 2. 90. 1755. *Bromus mollis* var. *hordeaceus* (L.) Fries, Novit. Fl. Suec. 16. 1814-23. *Bromus mollis* subsp. *hordeaceus* (L.) Hiitonen, Suom. Kasvio 219. 1933. Type: EUROPE: in collibus aridissimis sabulosis. (lectotype: [icon] *"Gramen avenaceum pratense, gluma breviore squamosa et villosa"* in Morison, Pl. Hist. Univ. 3: s. 8, pl. 7, f. 18. 1699, designated by Smith in Cafferty et al., Taxon 49:248. 2000; epitype: LINN-93.7, designated by Smith in Cafferty et al., Taxon 49:248).

Bromus mollis L., Sp. Pl., ed. 2. 112. 1762. *Serrafulcus mollis* (L.) Parl., Pl. Rar. Sic. 2:11. 1840. *Forasaccus mollis* (L.) Bubani, Fl. Pyr. 4:386. 1901. *Bromus hordeaceus* var. *mollis* (L.) Fiori, Nuov. Fl. Italia. 1:149. 1923. *Bromus hordeaceus* subsp. *mollis* (L.) Maire, Cat. Pl. Maroc. 4:943. 1941. Type: EUROPE: in australioris siccis (lectotype: LINN-93.6, designated by Smith in Cafferty et al., Taxon 49:248. 2000).

Annual; rhizomes absent; plants 7–110 cm tall. Culms 0.8–5 mm wide at base, smooth; nodes 2–4, yellow-brown, minutely to densely pubescent, hairs soft or stiff, to 0.6 mm long. Leaf sheaths closed for most of their length, moderately to densely pilose, hairs soft and wavy to 1.2 mm long; auricles absent; ligules 1–2.6 mm long, membranous, glabrous or pubescent, erose; blades 2.2–18 cm long, 1–5.3 mm wide, adaxial surface densely pubescent with long, stiff hairs to 1.2 mm long, abaxial surface pubescent with dense hairs to 0.3 mm long or like adaxial surface, margins smooth or serrulate. Panicles 2.5–14 cm long, 1–4 cm wide, dense, sometimes reduced to a single spikelet; branches erect to ascending or somewhat lax, scabrous to pubescent, most shorter than spikelets, 1 spikelet per branch; lowest inflorescence node with 1–3 branches. Spikelets 1.7–3 cm long (including awns), ovate-lanceolate, rachillas sometimes visible at maturity, florets 6–11. Glumes subequal, minutely to densely pubescent, keels serrulate; lower glumes 5.2–7 mm long, 3–5-nerved; upper glumes 6–8.5 mm long, 7–9-nerved. Lemmas 7.5–9 mm long, 1.9–2.5 mm wide, 7–9-nerved, nerves visible and conspicuously raised, particularly apically, backs densely pubescent with hairs to 0.3 mm long,

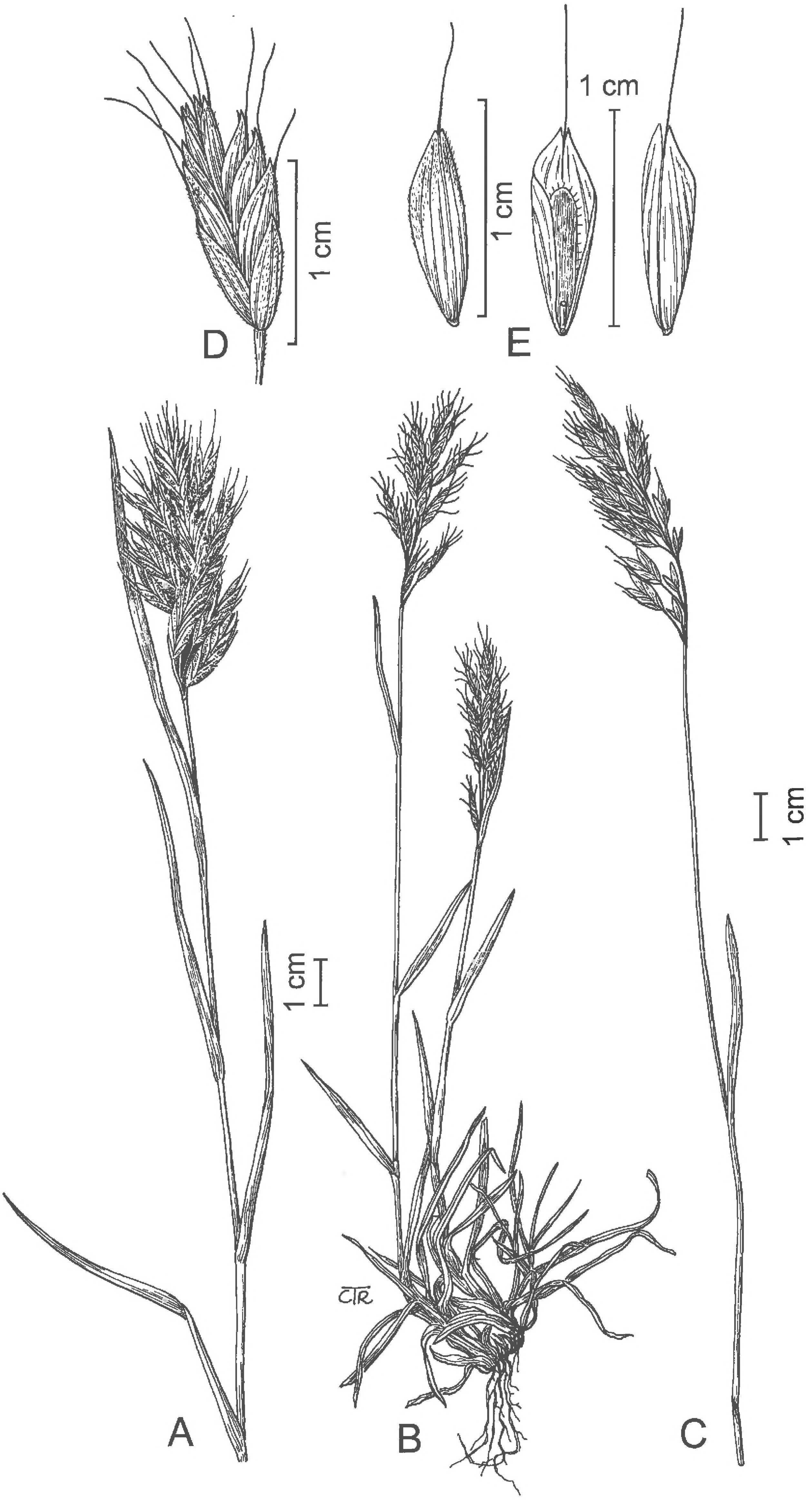

Fig. 6. *Bromus hordeaceus*. A, B, C. Habit. D. Spikelet. E. Lemmas.

hyaline margins 0.3–0.6 mm wide, often bluntly angled; apex bifid, the cleft 0.3–0.7 mm deep; awns 4–7.6 mm long, arising 0.4–1.2 mm below lemma apex, straight or slightly divaricate, antrorsely scabrous. Paleas shorter than lemmas, backs glabrous, keels ciliate, cilia to 0.3 mm long. Stamens 2; anthers 0.3–1.3 mm long, dark brown. $2n = 28$.

Distribution and Habitat.—Introduced. *Bromus hordeaceus* is thought to be native to the Meditteranean basin (Smith 1986). It is now distributed widely in North America (Pavlick & Anderton 2007), Europe, Africa and Australia. In British Columbia *B. hordeaceus* occurs throughout the southern portion of the province and on the Queen Charlotte Islands (Fig. 5B). It is distributed in waste places, roadsides, fields, grassy areas and sandy beaches. Elevation: 0–1110 m.

Common Names.—English: soft chess, soft brome-grass, soft cheat, tender brome-grass, soft-brome, soft brome; French: brome mou, brome doux, brome mollet.

Notes.—*Bromus hordeaceus* can be very difficult to distinguish from *B. racemosus*, even with considerable experience. These taxa have been lumped by some workers, reflecting this difficulty (e.g., Wilken & Painter 1993), but most workers recognize both taxa. Their major distinguishing characteristic is the degree of lemma nerve protrusion. In *B. hordeaceus*, the lemma nerves are raised and conspicuous (Fig. 7B), whereas in *B. racemosus* the lemmas are smooth, with nerves raised barely or not at all (Fig. 7A). This character is usually most easily observed near the apex of the lemma. *Bromus hordeaceus* tends to have more dense inflorescences compared with *B. racemosus*, but there is variation in this character and it is not always reliable.

Bromus hordeaceus is a morphologically variable species (Fig. 6). In Europe, most workers recognize several intraspecific taxa (as subspecies) in the complex, differentiated by lemma length, awn width at its base, awn curvature, culm height and spikelet pubescence (e.g., Smith 1968, 1980, 1985; Zajac 1996). These subspecies are generally difficult to tell apart, but they have been recognized in recent treatments for North America (e.g., Pavlick 1995; Pavlick & Anderton 2007). Two subspecies [subsp. *hordeaceus* and subsp. *thominei* (Hardham ex Nyman) Braun-Blanquet] were recognized in British Columbia by Douglas et al. (2001). Douglas et al. (2001) also indicated that the putative hybrid *B. x pseudothominei* P.M. Sm. (*B. hordeaceus* subsp. *hordeaceus* × *B. lepidus* Holmberg) is infrequent on southern Vancouver Island.

In material of the *B. hordeaceus* complex from British Columbia, I have observed that many individuals have a combination of the morphological characters typically used in keys to distinguish the subspecies, and they cannot be reliably differentiated. Specimens of the putative hybrid are also indistinguishable from other *B. hordeaceus* individuals. Ainouche et al. (1996, 1999) found no evidence of DNA sequence or allozyme differentiation among individuals of the putative *B. hordeaceus* subspecies collected from throughout their native eastern Meditteranean ranges, and also noted substantial overlap in morphological characters traditionally used to segregate intraspecific taxa among populations they examined. Intraspecific taxa in this group in North America are not recognized here.

Representative Specimens Examined. **CANADA. British Columbia:** Victoria, 6 Jun 1893, *Wm. Scott s.n.* (DAO); Cascade Station, near International Boundary between Kettle and Columbia rivers, 26 Jun 1902, *J.M. Macoun 63,330* (US); Armstrong, 29 Jun 1907, *E. Wilson s.n.* [?] (UBC); vicinity of Victoria, 13 Jun 1908, *J. Macoun 76853* (US); Vancouver Island, Robertson River, 5 Jul 1911, *W. Spreadborough s.n.* (CAN); Victoria, 13 Sep 1909, *A.S. Hitchcock 4863* (US); Spence's Bridge, 16 Jul 1913, *J. Davidson s.n.* (UBC); Mayne Island, 20 May 1914, *J.M. Macoun 90,077* (US); White Rock, 4 Jun 1916, *J. Davidson s.n.* (UBC); Vancouver, 10th Ave. and Willow St., Jun 1918, *J. Davidson s.n.* (UBC); Lulu Island, 15 Jun 1924, *T.R. Ashlee s.n.* (UBC); White Rock, 25 May 1924, *T.R. Ashlee s.n.* (UBC); Mante [?] Creek, June 1927, *Bostock s.n.* (DAO); Agassiz, 3 Sep 1930, *H. Groh s.n.* (DAO); Langley Prairie, 4 Sep 1930, *H. Groh s.n.* (DAO); Abbotsford, 12 Sep 1930, *H. Groh s.n.* (DAO); Sumas Prairie, 15 Sep 1930, *H. Groh s.n.* (DAO); Sooke, 6 Oct 1930, *H. Groh s.n.* (DAO); Mt Lehman, 12 May 1931, *H. Groh s.n.* (DAO); New Westminster, 19 May 1931, *H. Groh s.n.* (DAO); New Westminster, 19 May 1931, *H. Groh s.n.* (DAO); Horseshoe Bay, 23 May 1931, *H. Groh s.n.* (DAO); Saanichton, 27 May 1931, *H. Groh s.n.* (DAO); Langley Prairie, 30 May 1931, *H. Groh s.n.* (DAO); Agassiz, 2 Jun 1931, *H. Groh s.n.* (DAO); S bank of Fraser River, N Ladner, 7.5.1932, *E.P. Hume 602* (UBC); Saanichton, Vancouver Island, 24 Jun 1935, *A.M. Eastham s.n.* (UBC); Lower Fraser, 18 Jul 1935, *P.P. Henson s.n.* (DAO); Coal Harbour, 25 Jun 1936, *L.E. Taylor 2414* (UBC); Crescent Beach, 31 May 1937, *J.W. Eastham 469* (UBC); Summerland, May 1936, *V.C. Brink s.n.* (UBC); W Point Grey, Vancouver, 27 Jun 1937, *J.W. Eastham s.n.* (UBC); Nanaimo, 31 May 1939, *J.W. Eastham s.n.* (UBC); Saanichton, Jun 1939, *W.R. Foster s.n.* (DAO, UBC); Vancouver Island, Saanichton, 5 Jul 1939, *I. Mounce s.n.* (DAO); Duncan, 7 Jul 1939, *W. Newton s.n.* (DAO); Langley Prairie, 26 Jul 1939, *H. Groh 322* (DAO); Otter, 1 Aug 1939, *H. Groh 381* (DAO); Vancouver Island, Shelter Point, 5 mi N of Oyster River, 5 Aug 1939, *I. Mounce s.n.* (DAO); James Island, off Saanichton, 5 Aug 1939, *H. Groh 438* (DAO); Kamloops, Brigade Lake, 2800 ft, 24 Jul 1940,

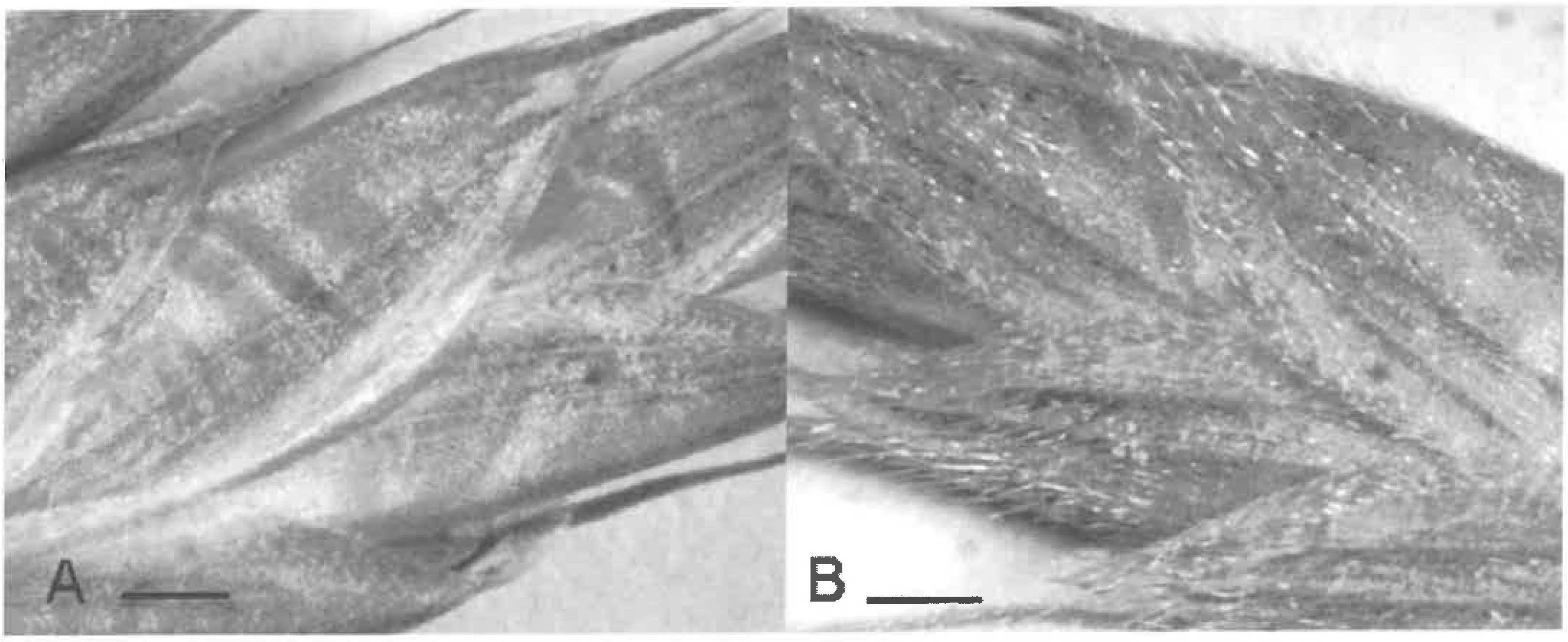

Fig. 7. Lemma morphology. A. ***Bromus racemosus [Saarela, Sears & Maze 586A*** **(CAN)]. Lemma surface is smooth; nerves are not conspicuously protruding. B.** ***Bromus hordeaceus [McCalla 8256*** **(UBC-61258)]. Lemma surface is rough; nerves are conspicuously protruding. Scale bars = 1 mm. Note that the presence or absence of lemma pubescence is not useful in distinguishing these taxa.**

E.W. Tisdale 40-7 (US); Nelson, 20 Jun 1944, *W.G. McCalla 8256* (DAO); N of Fraser River, Mission, 500 ft, 7 Aug 1949, *G.F. Ledingham 49-513* (DAO); Duncan, 19 Jul 1950, *E. G. Anderson 972* (DAO); Old W Saanich Road near Victoria, drainage of Colquitz Creek, 390 ft, 22 May 1963, *A. Young & W. Hubbard s.n.* (DAO); Gorden Head, 10 ft, 18 May 1965, *B.W. Davies 397* (DAO); Gillespie Road, East Sooke, 30 May 1965, *B.W. Davies s.n.* (DAO); Government House, Victoria, 200 ft, 7 Jun 1965, *R. A. Keller & B.W. Davies 822* (DAO); above Harrison River, 1 mi from Harrison Mills, 400 ft, 12 Jun 1974, *K.I. Beamish, J. Pinder-Moss, C. Selby, J. Pojar & E. Perkins 74063* (UBC); Long Lake Road, S of Kamloops, 24 Jul 1939, *J. Davidson s.n.* (UBC); Ladner, 14 Jul 1943, *H.D. Falls s.n.* (UBC); Snake Island, W Nanaimo, 30 May 1944, *L.E. Taylor 2296* (UBC); Locarno Park, 11 Jun 1944, *J.W. Eastham s.n.* (DAO); Nelson, 20 Jun 1944, *W. C. McCalla 8256* (UBC); Nelson, 21 Jun 1944, *W.C. McCalla 8267* (UBC); Hastings Park, Vancouver, 8 Jun 1923, *T.R. Ashlee s.n.* (UBC); #3 Hwy W of Nelson, 23 Jun 1944, *W.C. McCalla 8280* (UBC); edge of Hwy 3, 6 mi W of Nelson, 20 Jun 1944, *W.C. McCalla 8256* (DAO); Gray Creek, 27 Jun 1944, *W.C. McCalla 8308* (UBC); Fairfield Island, Chilliwack, 10 Jun 1946, *J.W. Eastham s.n.* (UBC); Victoria, above McNeil Bay, 60 m, 21 May 1950, *V. Krajina & R.H. Spilsbury 3946* (UBC); Bear-Cowichan Lakes, 270 m, 28 May 1950, *V. Krajina & R.H. Spilsbury 4096* (UBC); Quinsam Lake, Comox, 1 Jun 1951, *J. Bendell s.n.* (UBC); Gully at W Summerland on W side of Okanagan Lake, 27 Jun 1953, *J.A. Calder & D.B.O. Savile 9711* (DAO); along highway on W side of Skaha Lake between Penticton and Kaleden, 28 Jun 1953, *J.A. Calder & D.B.O. Savile 9784* (DAO); Goose Lake about 3 mi N of Vernon, 6 Jul 1953, *J.A. Calder & D.B.O. Savile 10145B* (DAO); 5 mi W of Ross Creek along the highway, 3100 ft, 29 Aug 1953, *V.J. Krajina s.n.* (UBC); Port Alberni, 17 May 1955, *D.R. Lindsay & W. Woodbury 658* (DAO); Christina Lake, 31 May 1954, *W.G. Dore & M. Smith s.n.* (DAO); Boston Bar, 30 May 1955, *D.R. Lindsay & W. Woodbury 862* (DAO); Saltspring Island, islet off Beaver Point, 9 Jul 1955, *T.R. Ashlee s.n.* (UBC); Deadwood Creek area, Nanaimo River Valley, 840 ft, 22 Jun 1956, *D. Mueller-Dombois 90-3* (UBC); Queen Charlotte Islands, Graham Island, Queen Charlotte City, 29 Jul 1957, *J.A. Calder, D.B.O. Savile & R.L. Taylor 23000* (DAO, UBC); Moresby Island, just S of Sandspit along road to Copper Bay, 5 Aug 1957, *J.A. Calder, D.B.O. Savile & R.L. Taylor 23207* (DAO); W Vancouver, sea level, 27 May 1960, *K. Beamish & F. Vrugtman 60501* (UBC); Java Rocks, Saturna Island, 8 Jun 1961, *T.R. Ashlee s.n.* (DAO); 100 yds W of entrance to Johnstone Creek campsite W of Rock Creek on Hwy 3, 15 Jun 1961, *G. Beke 61-81* (DAO); Happy Valley near Victoria, 30 May 1962, *J. Hett s.n.* (DAO); Queen Charlotte Islands, Graham Island, S end of Richardson Ranch at Tlell, 4 Jun 1964, *J.A. Calder, R.L. Taylor & L.C. Sherk 34658* (DAO, UBC); 2 mi E of Queen Charlotte City, Graham Island, 8 Jun 1964, *J.A. Calder, R.L. Taylor & L C. Sherk 34872* (DAO); S of Richardson Ranch farmstead, Tlell, Graham Island, 14 Jul 1964, *J.A. Calder & R.L. Taylor 35920* (DAO); Moresby Island, just S of Sandspit near radio tower on road to Copper Bay, 18 Jun 1964, *J.A. Calder & R.L. Taylor 35166* (DAO); Lawn Point N of Skidegate Mission, Graham Island, 24 Jun 1964, *J.A. Calder & R.L. Taylor 35445* (DAO); Smugglers Cove, Ten Mile Point, 10 ft, 19 May 1965, *B.W. Davies 448* (DAO); Esquimalt Lagoon, 1 Jun 1965, *B.W. Davies & R.A. Keller 699* (DAO); Rocky Point, 100 ft, 8 Jun 1965, *B.W. Davies & R.A. Keller 844* (DAO); Ten Mile Point area, 20 ft, 20 May 1965, *B.W. Davies 482* (DAO); Lock Bay, Gabriola Island, 4 Jul 1965, *K. Wade 65-57* (UBC); near Harling Point below Gonzales Hill, Victoria, 15 Jul 1966, *A.S. Harrison 111.1* (DAO); Ross Lake, Skagit River Valley, near Canada-U.S.A. border, ca. 1000 ft, 12 Jun 1974, *K.I. Beamish, J. Pinder-Moss, C. Selby, J. Pojar & E. Perkins 74040* (DAO, UBC); Mount Warburton-Pike, Saturna Island, 14 Jun 1974, *G. Krause s.n.* (UBC); UBC campus, S of Asian Centre, 29 Jun 1975, *A. Guppy s.n.* (UBC); 1 mi NE of Kaleden, 1800 ft, 23 May 1977, *B. Wikeem & S. Gale s.n.* (UBC); SW coast of Vancouver Island, China Beach, 2 Aug 1980, *H.L. Dickson et al. 3804* (DAO); Harrison Hot Springs, along road which goes along Harrison Lake to Sasquatch Provincial Park, 6 Aug 1980, *H.L. Dickson 3856* (DAO); W end of Manning Provincial Park, Hwy 3 at 2 Mile Creek, 2 km E of Hope, 29 Jun 1982, *S.G. Aiken & S.J. Darbyshire 2081* (DAO); Cowichan District, Salt Spring Island, Mount Taum, above Cape Keppel, 950 ft, 3 Jul 1982, *S.G. Aiken, S.J. Darbyshire & L.E. Pavlick 2140* (DAO); Pacific Rim National Park, Long Beach, Schooner Trail, 4 Jul 1982, *S.G. Aiken & S.J. Darbyshire 2171* (DAO); Pacific Rim National Park, Long Beach Unit, Wickaninnish Beach, Quisitis Point, 5 Jul 1982, *S.G. Aiken & S.J. Darbyshire 2173* (DAO); Vancouver, UBC, along Chancellor Blvd., near University Hill Elementary School, Univ. Endowment Lands, 28 May 1986, *G.B. Straley 3592* (UBC); Galiano Island, W of Stockade Hill, overlooking Montague Harbour, 17 Aug 1986, *W. Crins 7349* (UBC); Meager Creek Hot Springs, N of Pemberton, Lillooet District, 150 m, 1 Jun 1987, *A.A. Rose s.n.* (UBC); Abbotsford, intersection of Hwys. 1 and 11 along ramp, 29 Jun 1988, *S.J. Darbyshire 3729* (DAO); Mount Bruce, summit, 3 Jul 1988, *S.J. Darbyshire & J A. Darybshire 3777* (DAO); 0.25 km E of Vaseux Lake, 1110 m, 13 Jun 1991, *G.W. Douglas 12541* (UBC); Vaseux Lake, S end of Mud Lake, W side, 13 Jun 1991, *T. Goward 91-435* (UBC); Abbotsford Dist. Munic., near base of Sumas Mt, 25 May 1995, *H. Kennedy, F.R. Ganders, M. Marshall, D. Justice & L. Goertzen s.n.* (UBC); Sooke hills, Ragged Mountain ERP, 380 m, 27 Jun 1996, *J.L. Penny & H. Roemer 82* (UBC); along Hwy 33, 33.5 km S of Beaverhill, 25 Jun 2003, *J.M. Saarela & A. Roe 255* (CAN); alongside parking lot at UBC Museum of Anthropology, 25 May 2005, *J.M. Saarela 300* (CAN, UBC); Kuskanook Rest Area, Kuskanook Harbour Society, 24 May 2006, *J.M. Saarela 452* (CAN, UBC); Horseshoe Bay, Whytecliff Park, 27 May 2006, *J.M. Saarela 507* (CAN, UBC); Horseshoe Bay, Eagleridge Drive, just S of Hwy 1 (Trans-Canada Highway), 27 May 2006, *J.M. Saarela 513* (CAN, UBC); Ladner, S side of Canoe Passage, W terminus of River Road, 28 May 2006, *J.M. Saarela & C. J. Sears 537, 538* (CAN, UBC); W of Osoyoos, 1.3 km up Richter Mountain Road, 19 Jun 2006, *J.M. Saarela, C.J. Sears & J. Maze 632* (CAN, UBC); 0.5 km up Grizzly Road, S of Hwy 3, ca. 5 km E of Osoyoos, 20 Jun 2006, *J.M. Saarela, C.J. Sears & J. Maze 646* (CAN, UBC); roadside pullout on W side of Hwy 1 (TransCanada) at Hells Gate, 22 Jun 2006, *J.M. Saarela, C.J. Sears & J. Maze 734* (CAN, UBC); Richmond, London Farm, Gilbert Beach, just E of London's Landing, 28 May 2006, *J.M. Saarela & C. J. Sears 523a* (CAN, UBC); Ladner Harbour Park, 28 May 2006, *J.M. Saarela & C. J. Sears 531* (CAN, UBC); Mayne Island, cliff edge of Mount Parke, ca. 1 km W of highest point where radar tower is, 3 Jun 2007, *J.M. Saarela, D.M. Percy, Y. Chang, & Q.C.E. Cronk 803* (CAN, UBC); Vancouver Island, Island View Park, S of Hwy 17 between Sidney and Victoria, along coast, 4 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 851* (CAN, UBC); Vancouver Island, Thetis Lake Regional Park, just N of Hwy 1, N of Langford, 4 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 859* (CAN, UBC); Vancouver Island, just S of Chemanus along Hwy 1A, 4 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 906* (CAN, UBC); Vancouver Island, just off Hwy 19A along Crane Road, N of Qualicum Beach, at confluence of Nile Creek and the Straight of Georgia, 7 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 934a* (CAN, UBC); Queen Charlotte Islands: Moresby Island, Moresby Camp, Gillett Arm of Cumshewa Inlet, 11 km from Y junction of the loop road, 25 Jul 2007, *J.M. Saarela & D. M. Percy 1271* (CAN, UBC).

6. Bromus inermis Leyss., Fl. Halens. 16. 1761. (**Figs. 5C, 8A–E**). *Festuca inermis* (Leyss.) DC. & Lam., Fl. Franc. 3:49. 1805. *Schedonorus inermis* Beauv., Ess. Agrost. 99:177. 1812. *Forasaccus inermis* (Leyss.) Lunell, Amer. Midl. Naturalist 4:225. 1915. *Zerna inermis* (Leyss.) Lindm., Svensk Fanerogamfl. 101. 1918. *Bromopsis inermis* (Leyss.) Holub, Folia Geobot. Phytotax., Praha 8:167. 1973. Type: EUROPE. Germany: in pratis fertilibus succulentis Pomariis in den Pulverweiden im Amstgarten ad Belberg Crollwitz et alibi frequens, *Leysser s.n.* (holotype: LINN).

Bromus pumpellianus var. *melicoides* Shear, Bull. Div. Agrostol., U.S.D.A. 23:50. 1900. Type: U.S.A. Colorado: Beaver Creek Camp, alt. ca. 3400 m, 8 Jul 1896, *L. H. Pammel s.n.* (holotype: US-81589!). Note: Hitchcock (1935) and Pavlick et al. (2003) included this taxon as a synonym of *B. pumpellianus*, but the holotype clearly is *B. inermis*, based on the absence of awns and scarce lemma pubescence.

Bromus inopinatus Brues, Trans. Wis. Acad. Sci. 17:73. 1911. Type: U.S.A. Wisconsin: Milwaukee, McKinley Park, along shores of Lake Michigan, 21 [no month] 1904, *B.B. Brues 78* (isotype: US-3168443!, fragment).

Bromus inermis f. *proliferus* Louis-Marie, Rev. Oka Agron. Inst. Agric. 14:14. 1940. Type: Canada, Quebec: La Trappe, 24 Aug 1931, *P. Louis-Marie 318* (holotype: QFA).

Bromus inermis f. *bulbiferus* Moore, Rhodora 43:76. 1941. Type: U.S.A. Minnesota: Ramsey County, Cleaveland Ave., 4 mi N of the campus of Minnesota College of Agriculture, 11 Oct 1938, *Kaufman s.n.* (holotype: MINN).

Perennial; strongly rhizomatous; basal leaves decaying into straight fibres, though not readily, plants 21–150 cm tall. Culms 2.9–6 mm wide at base, smooth; nodes 3–4, brown, glabrous or minutely pubescent, hairs to 0.2 mm long. Leaf sheaths closed for most of their length, glabrous or pubescent with soft hairs to 1.2 mm long or stiff hairs to 0.6 mm long; auricles absent or rudimentary; ligules 1.5–3.5 mm long, membranous, glabrous, erose; blades 10–21.5 cm long, 3.8–11.5 mm wide, adaxial surfaces glabrous with occasional long, soft hairs to 1.2 mm long or with dense soft hairs to 0.8 mm long, abaxial surfaces glabrous or pubescent with short hairs to 0.3 mm distributed along blade center, margins serrulate. Panicles 6.5–22 cm long, 3.5–14 cm wide, open; branches erect to ascending, often nodding at maturity, scabrous, usually longer than spikelet, 1–5 spikelets; lowest inflorescence node with 3–7 branches. Spikelets 1.7–3.2 cm long (including awns); florets 7–10. Glumes subequal, lanceolate, glabrous, midnerves scabrous or with hairs to 0.2 mm long; lower glumes 4.1–7 mm long, 1(–3)-nerved; upper glumes 6–9.5 mm long, 3-nerved. Lemmas 10–13.5 mm long, 1.5–2.5 mm wide, glabrous or variously scabrous or puberulent on lower 1/6 to ¼, nerves scabrous; awns absent or to 3 mm long, arising 0–0.5 mm below lemma apex, straight, antrorsely scabrous. Paleas 8–10.5 mm long, shorter than lemmas, keels ciliate throughout, the cilia ca. 0.2 mm long. Stamens 3; anthers 4–5.5 mm long, yellow. $2n = 28, 56$.

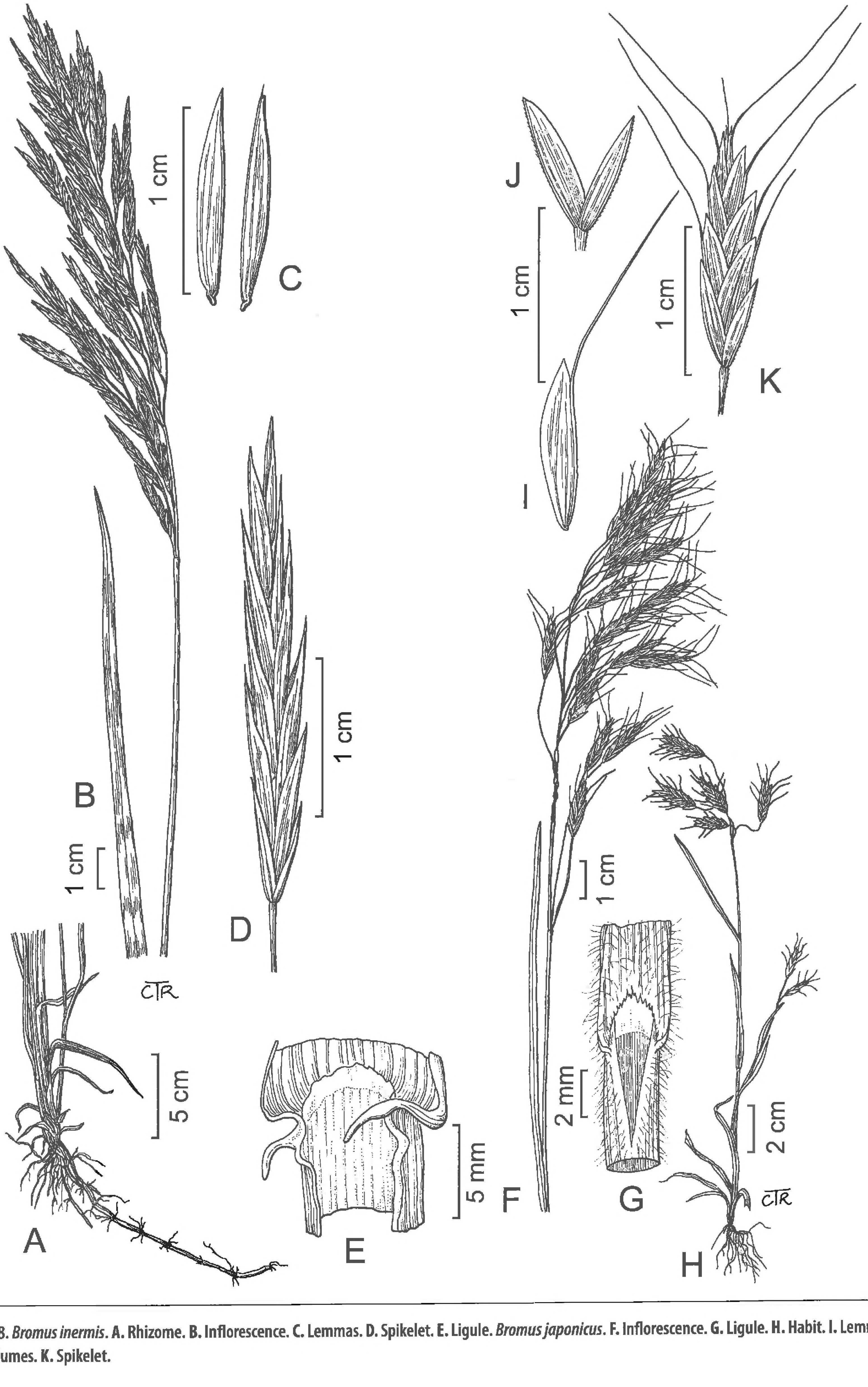

Fig. 8. *Bromus inermis*. A. Rhizome. B. Inflorescence. C. Lemmas. D. Spikelet. E. Ligule. *Bromus japonicus*. F. Inflorescence. G. Ligule. H. Habit. I. Lemma. J. Glumes. K. Spikelet.

Distribution and Habitat.—Introduced. *Bromus inermis* is native across central Eurasia, and introduced in Africa, Australia, North America and South America. It is distributed widely across North America and it is extremely common (Pavlick & Anderton 2007). *Bromus inermis* has been collected throughout British Columbia, mostly on southern Vancouver Island, in the Vancouver area and east of the coastal ranges (Fig. 5C; also see Otfinowski et al. 2007:188). Habitats include roadsides, fields and pastures, wet meadows and open woods. Elevation: 0–1256 m.

Common Names.—English: Austrian brome, Austrian brome grass, awnless brome, awnless brome grass, Hungarian brome, Hungarian brome grass, Hungarian fodder grass, Russian brome, smooth brome, smooth brome grass; French: brome inerme, brome de Hongrie, brome sans arêtes.

Notes.—The introduced *B. inermis* and the native *B. pumpellianus* have been variously treated as the same (e.g., Elliott 1949; Wagnon 1952; Scoggan 1978) or separate species (e.g., Pavlick 1995; Pavlick & Anderton 2007). Elliott (1949) demonstrated that the taxa are partially interfertile and presented morphological evidence (i.e., intermediate specimens) indicating that hybridization has likely occurred between the taxa. Nevertheless, the taxa have different morphological characteristics and native distributions and they occur in different habitats, suggesting that they have independent evolutionary histories. *Bromus inermis* is also morphologically similar to the relatively recently introduced *B. riparius* (see discussion under that taxon).

Bromus inermis was introduced into North America in 1884 by the California Agricultural Experimental Station. In Canada it is widely cultivated for hay and pasture and used in revegetation projects, but although economically beneficial as forage, *B. inermis* is extremely invasive and poses serious threats to Canadian ecosystems (Otfinowski et al. 2007). It was recently ranked as the 8th most serious invasive alien plant threatening natural habitats in Canada (Catling & Mitrow 2005). Otfinowski et al. (2007) provide a detailed review of the biology of *Bromus inermis*.

Representative Specimens Examined. **CANADA. British Columbia:** Bridge Creek, 21 Sep 1896, *W. Allan s.n.* (UBC); Goldstream, Okanagan, 11 Jul 1904, *J.R. Anderson s.n.* (UBC); Kamloops Lake, 4 Jul 1906, *E. Wilson 678* (UBC); Coombe, Surrey, 27 Jun 1910, *C. E. Britton s.n.* (UBC); E of Field, 1-2 Aug 1914, *A.S. Hitchcock 11543* (US); Big Creek, Jun 1915, *M. Bertrand s.n.* (UBC); Vernon, 20 June 1917, *E.M. Warren s.n.* (UBC); Quesnel Dam, 1 Nov 1917, *W. Newcombe 317* (UBC); Merritt, 28 Aug 1920, *G.W. Copley 10-9* (UBC); Castlegar, 3 Jul 1937, *J.W. Eastham s.n.* (UBC); Procter, Nelson, 7 Jul 1937, *J.W. Eastham s.n.* (UBC); Ymir Rd, Nelson, 10 Jul 1937, *J.W. Eastham s.n.* (UBC); Mirror Lake, Kaslo, 12 Jul 1937, *J.W. Eastham s.n.* (UBC); Marble Mts, Hat Creek Valley, 26 Jun 1938, *J.W. Thompson & E.M. Thompson 228* (CAN); Kamloops, Dominion Experimental Station, 12 Jun 1940, *J.W. Eastham s.n.* (UBC); Manning Park, Hope-Princeton, 9 Aug 1945, *G.A. Hardy s.n.* (UBC); Cache Creek, 29 Jul 1946, *J. A. Rattenbury s.n.* (UBC); Prince George, 20 Jul 1955, *S. Lenaelou 16* (UBC); 2nd Trapp Lake, Kamloops, 19 Aug 1950, *V.J. Krajina s.n.* (UBC); Kamloops District, Trap Lake, 27 Aug 1950, *V.J. Krajina s.n.* (UBC); Edgewood, Arrow Lake, 1500 ft, 9 Jun 1957, *K. Beamish & A. Gilmartin 7288* (UBC); Keene Creek, Kaslo, Kootenay, 16 Jul 1960, *M. Bell s.n.* (UBC); Tranquille, 6 Oct 1962, *V.C. Brink s.n.* (UBC); Mt Seymour summit, Aug 1963, *H. H. Ross s.n.* (UBC); Chilcotin, plot no. 110, Aug 1968, *C. Beil 68-8-14* (UBC); Fort Nelson near Mile 300 of the Alaska Highway, 3 Jul 1970, *R.M. Annas, V.J. Krajina & R.G. McMinn s.n.* (UBC); Maxhamish Lake, 7 Jul 1970, *R.M. Annas, V.J. Krajina & R.G. McMinn s.n.* (UBC); Cariboo Parklands, near confluence of Chilcotin and Fraser Rivers, 20 Jun 1972, *J.F. Hyne 156* (UBC); Lakit Mountain lookout, 18 Aug 1974, *F. Fodor 940* (UBC); Callanan Lake, Chilcotin, 8 Jul 1975, *D. Jenkins 10122* (UBC); 3 mi W of Red Pass Park Headquarters, 17 Jul 1975, *C.C. Chuang 75/5* (UBC); Sundance Lake, Peace River District, 2200 ft, 3 Jul 1978, *A.A. Rose AAR 78* (UBC); Brunswick Pt. delta, 6 Jun 1979, *G.E. Bradfield 91* (UBC); Ray Farm, 11 km S of Clearwater Lake, Wells Gray Park, 21 Jun 1979, *T. Goward 81-326* (UBC); along Rt. 12, ca. 47 km W of jct with Rt. 97, N of Cache Creek, 21 Jun 1983, *G.B. Straley 2691* (UBC); New Westminster, 18 May 1989, *F. Lomer 89-015* (UBC); Osoyoos area, just NE of Chapaka border crossing, W bank Similkameen River near border (Indian Reserve), 2 Jun 1990, *T. Goward 90-804* (UBC); along road to Tumbler Ridge, a few km S of junction with Rt. 97 at Arras, near Dawson Creek, 27 Jul 1991, *G.B. Straley & K.W. Nicholls 6866* (UBC); Spatsizi, Cold Fish Lake, 16 Aug 1992, *V.C. Brink s.n.* (UBC); Kootenay, Grand Forks, Gilpin Forest Service Road, E of Grand Forks, 23 Jun 1993, *L.E. Pavlick 93-141* (UBC); Kootenay, Windermere Creek, adjacent to creek at Boy Scout Camp "Woodsmoke", 27 Aug 1998, *H. Stewart 98091808* (UBC); 18 mi N of Dease Lake (Brady Creek) on Hwy 37 towards Watson Lake, 20 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18668* (CAN, US); 1 mi S of Iskut on Hwy 37 towards Meziadin Junction, along Coyote Creek, 20 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18673* (CAN, US); 18 mi N of Dease Lake (Brady Creek) on Hwy 37 towards Watson Lake, 20 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18668* (CAN, US); 1 mi S of Iskut on Hwy 37 towards Meziadin Junction, along Coyote Creek, 20 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18673* (CAN, US); along Hwy 3 at Kettle River, vacant lot beside river across from "Gold Pan Café and Store", 18 May 2006, *J.M. Saarela 345* (CAN, UBC); Fort Steele Road, corner of Hwy 3 and Wardner, 12 km W of Jaffray, 23 May 2006, *J.M. Saarela 412* (CAN, UBC); ca. 2 km E of Erickson along Hwy 3, 24 May 2006, *J.M. Saarela 439* (CAN, UBC); Osoyoos, Haynes Provincial Park, 25 May 2006, *J.M. Saarela 481, 485* (CAN, UBC); Ladner, S side of Canoe Passage, W terminus of River Road, 28 May 2006, *J.M. Saarela & C. J. Sears 540* (CAN, UBC); Manning Provincial Park, 0.9 km up road across from park lodge that goes to alpine area, 19 Jun

2006, *J.M. Saarela, C.J. Sears & J. Maze 566* (CAN); Princeton, across from Princeton High School, 19 Jun 2006, *J.M. Saarela, C.J. Sears & J. Maze 597* (CAN, UBC); along Finmore Road, W of Prince George, S of Stuart River Provincial Park, along small road S of road to Cobb Lake and N of Beverly Lake Forest Service Road, 18 Jul 2007, *J.M. Saarela & D. M. Percy 1033* (CAN, UBC); old gravel mining area, just S of Hwy 16, N of Bulkley River, just E of Ross Lake, 19 Jul 2007, *J.M. Saarela & D.M. Percy 1088* (CAN, UBC); S of 100 Mile House, down 83 Mile Road to Green Lake Prov. Park, 28 Jul 2007, *D.M. Percy 1366* (CAN, UBC).

7. Bromus japonicus Thunb. in Murray, Syst. Veg., ed. 14. 119. 1784. Thunb. Fl. Jap. 52. 1784, serius. **(Figs. 8F–K, 9A)**. *Bromus arvensis* var. *japonicus*, Nuov. Fl. Italia 1:149. 1923. *Serrafalcus japonicus* (Thunb.) Willmott., Man. Brit. Bot. (Babington), ed. 10. 510. 1922. Type: JAPAN: *Thunberg s.n.* (holotype: UPS).

Annual; rhizomes absent; plants 17–85 cm tall. Culms 1–2.2 mm wide at base, smooth; nodes 3–4, black-brown. Leaf sheaths closed for most of their length, densely pilose with soft, wavy hairs to 1.2 mm long; auricles absent; ligules 1–2.2 mm long, membranous, glabrous, apex erose; blades 3.5–13 cm long, 1–6 mm wide, adaxial and abaxial surfaces densely pubescent with short, stiff hairs to 0.6 mm long, margins smooth or serrulate. Panicles 3–26 cm long, 6–16 cm wide, open; branches spreading to ascending (lower branches sometimes nodding), flexuous, smooth to scabrous, usually longer than spikelets, 1–6 spikelets per branch, lowest inflorescence node with 1–6 branches. Spikelets 1.8–4.2 cm long, broadly oblong to ovate-lanceolate, terete to moderately compressed, rachillas sometimes visible at maturity, florets 7–15. Glumes subequal, smooth, margins sometimes hyaline; lower glumes 4–7 mm long, 3–5(–7)-nerved; upper glumes 5–8 mm long, 7–9-nerved. Lemmas 7–9.2 mm long, 1.2–2.2 mm wide, 7–9-nerved, nerves not conspicuous, backs glabrous or scabridulous, scabrules ca. 0.1 mm long, hyaline margins 0–0.5 mm wide at widest point, apex minutely bifid, the cleft to 1 mm deep; awns 4.2–13 mm long (awn on lowest lemma usually shorter), arising 1.5–2.6 mm below lemma apex, straight to strongly divergent, widest at base, antrorsely scabrous. Paleas 6–7 mm long, backs glabrous, keels ciliate, cilia 0.3–0.5 mm long. Anthers 2; stamens 0.6–1.1 mm long, brown. $2n = 14$.

Distribution and Habitat.—Introduced. *Bromus japonicus* is native to Europe. In North America, *B. japonicus* is distributed widely throughout the U.S.A. and in southern Canada (Pavlick & Anderton 2007). *Bromus japonicus* has been collected in various places throughout British Columbia; it is most common in the interior of the province (Fig. 9A). Habitats include roadsides, grassy areas, hillsides and meadows. Elevation: 152–1050 m. Whisenant (1990) suggested that *B. japonicus* has become problematic in areas that have reduced occurrence of fire and grazing by large animals.

Common Names.—English: Japanese chess, Japanese bromegrass, Japanese brome, spreading brome; French: brome du Japon, brome japonais.

Notes.—The authority for this name has been variously attributed to 'Thunberg', 'Thunberg ex Murray', 'Thunberg in Murray', and 'Murray', because it was published in both *Flora Japonica* (Thunberg, 1784, August) and *Systema Vegetabilum*, ed. 14 (Murray 1784, May-June), being attributed to Thunberg in the latter. Because of this confusion, Bartholomew et al. (Taxon 46:311-314. 1997) considered the author citations of the many new names published in these works and concluded that their authorship should be attributed to 'Thunberg in Murray' when a complete bibliographic citation is given (as above), or as 'Thunberg' when only the authority is provided.

Bromus japonicus and *B. squarrosus* are morphologically similar species, distinguished on the basis of their hyaline lemma margin widths and their degree of panicle branching (see Taxonomic Key). Some individuals with seemingly intermediate morphologies can be difficult to determine, but the taxa have consistently been recognized as distinct species in their native and introduced ranges. Molecular (Ainouche & Bayer 1997; Ainouche et al. 1999) and serological data (Smith 1972) indicate that they are closely related. Based on allozyme and morphometric data, Oja et al. (2003) suggested that the two taxa might be more appropriately recognized as intraspecific taxa of a single polymorphic species. Oja et al. (2003) did not, however, propose a formal taxonomic revision of the group. I recognize these taxa here at the species level.

Representative Specimens Examined. **CANADA. British Columbia:** Armstrong, 31 May 1928, *J.B. Munro s.n.* (V); near Kamloops, 2000 ft, 27 May 1934, *G.V. Copley 7* (US); Kamloops, Mission Flats, 1200 ft, 22 Jun 1937, *E.W. Tisdale 40-10* (US); Tranquille Ranges, Tranquille, 21 Jul 1939, *H. Groh 244* (DAO); 2 mi NW of Roosville, on overgrazed Indian Reserve, Jul 1947, *H.K. DeBeck s.n.* (DAO, UBC, V); Goose Lake

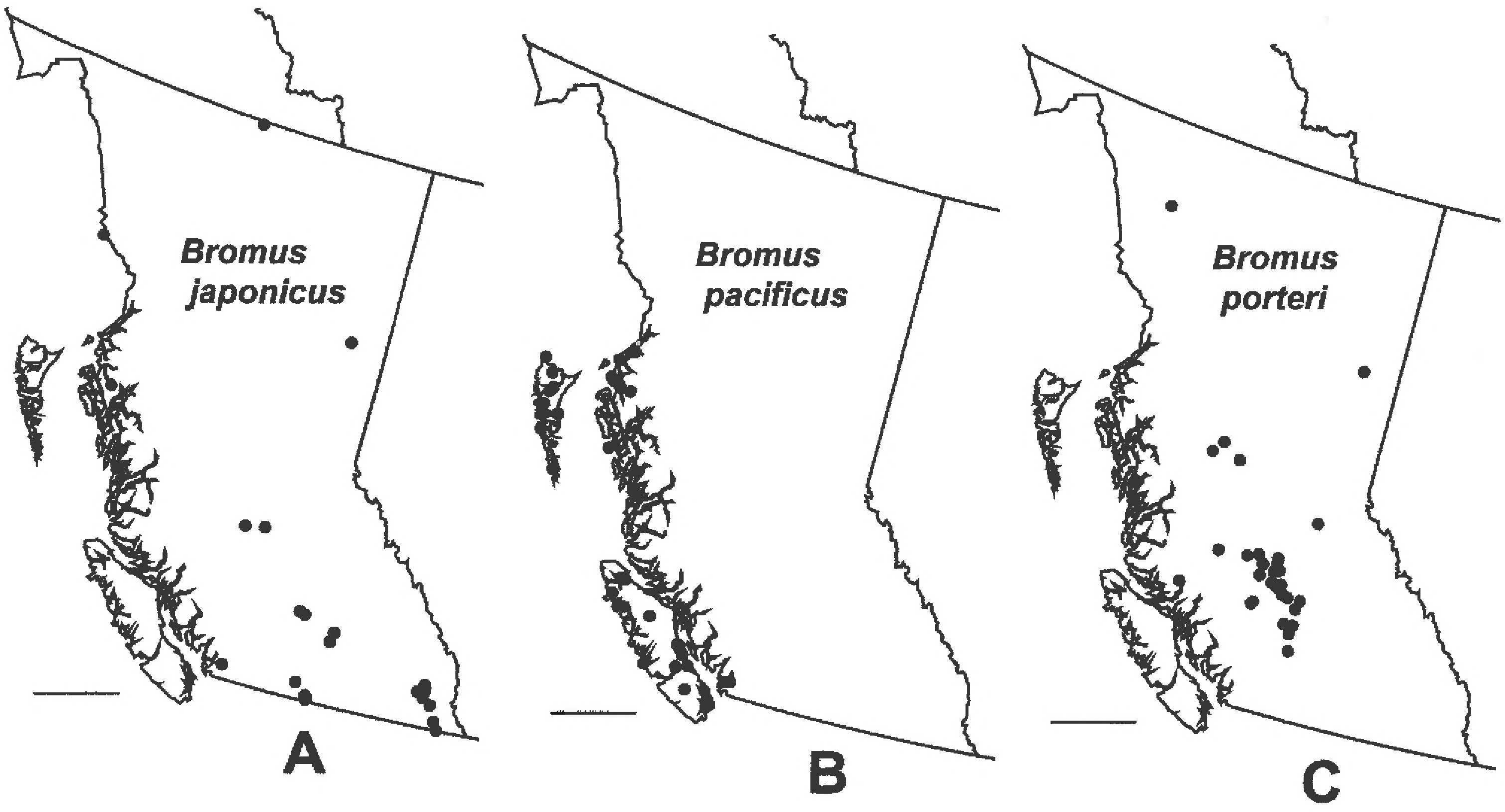

Fig. 9. Geographic distribution in British Columbia. A. *Bromus japonicus*. B. *Bromus pacificus*. C. *Bromus porteri*. Scale bars = 200 km.

about 3 mi N of Vernon, 6 Jul 1953, *J.A Calder & D.B.O. Savile 10145A* (DAO); 4.5 mi WSW of Kamloops, 2300 ft, 10 Jul 1953, *J.A.Calder & D.B.O. Savile 10297* (DAO, US); two mi W of Kamloops, 26 Jul 1955, *G.A. Mulligan & W. Woodbury 1817* (DAO); Stikine River, between Taya and Tahltan Rivers, 500 ft, 10 Sep 1977, *A.A. Rose 77-778* (UBC); Lake Koocanusa, Kikomun Creek Provincial Campground, 15 Jul 1993, *F. Lomer 93-117* (UBC); 7.6 km W of Osoyoos along Hwy 3, 25 May 2006, *J.M. Saarela 487* (CAN, UBC); 5.6 km S of Hwy 3 on Mount Kreger Road, South Okanagan Grasslands Protected Area, 20 Jun 2006, *J.M. Saarela, C.J. Sears & J. Maze 673* (CAN, UBC).

8. Bromus pacificus Shear, Bull. Div. Agrostol., U.S.D.A. 23:38, f. 21. 1900. (**Figs. 9B, 10A–E**). *Bromopsis pacifica* (Shear) Holub, Folia Geobot. Phytotax. 8:168. 1973. Type: U.S.A. Oregon. Clatsop Co.: in moist thickets near the seashore, S of Seaside, 11 Aug 1899, *C.L. Shear & F.L. Scribner 1703* (holotype: US-1867129!; isotype: US-81585!).

Bromus magnificus Elmer, Bot. Gaz. 36:53. 1903. Type: U.S.A. Washington. Clallam Co.: Aug 1900, *A.D.E. Elmer 1957* (holotype: DS; isotype: US-401765!, with additional locality information: "Olympic Mtns.").

Perennial; rhizomes absent; plants 45–172 cm tall. Culms 4–5 mm wide at base, smooth; nodes 5–9, brown, finely to densely retrorsely pubescent, hairs to 0.7(–1) mm long, occasionally glabrous with hairs above and below nodes. Leaf sheaths closed for most of their length, open for 14–35 mm in length, glabrous or sparsely to densely pilose with hairs to 2.1 mm long; auricles absent; ligules 2–4 mm long, membranous, glabrous, erose; blades to 32(–37) cm long, 7–16 mm wide, adaxial surface pilose, hairs to 1.5 mm long, soft and wavy, abaxial surface glabrous, margins smooth or serrulate. Panicles 17–28 cm long, 12.5–19 cm wide, open; branches mostly spreading and/or nodding, scabrous to pubescent, longer than spikelets, 1–6 spikelets per branch; lowest inflorescence node with 1–4 branches. Spikelets 2.1–3.8 cm long, ovate-lanceolate, terete to slightly compressed, rachillas sometimes visible at maturity, particularly distally; florets (4)6–8(10). Glumes slightly subequal, pubescent, hairs to 0.6 mm long, longer hairs sometimes restricted to keel; lower glumes 8.2–10.5 mm long, 1-nerved, lanceolate; upper glumes 9.7–12 mm long, 3-nerved, lanceolate to strongly acuminate with mucros 0–1.3 mm long. Lemmas 10–13.5 mm long, 1.8–2.3 mm wide, 7-nerved, sparsely to densely pubescent with appressed hairs to 1.5 mm long, longest hairs sometimes along margins, hairs sometimes denser on lower ½, apex entire or minutely bifid, the cleft 0–0.3 mm deep; awns 3–6.5(–7) mm long, arising 0–0.1 mm below lemma apex, straight, antrorsely scabrous. Paleas 9–10.5 mm long, usually shorter than lemmas, keels densely ciliate, cilia to 0.5 mm long. Stamens 3; anthers 2–3 mm long, dark brown. $2n = 28$.

Distribution and Habitat.—Native. *Bromus pacificus* occurs along or near the Pacific coast from south-

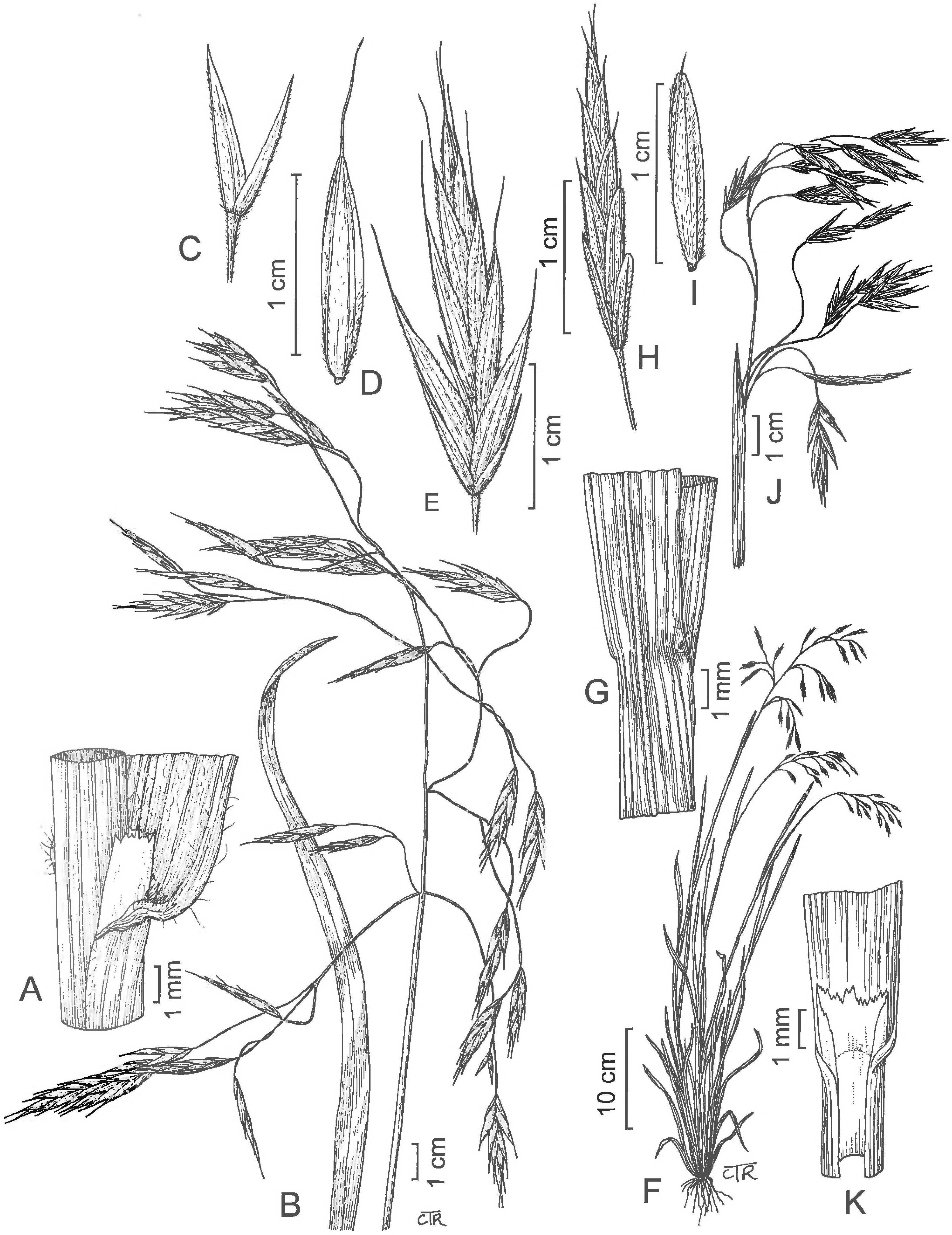

Fig. 10. *Bromus pacificus*. **A.** Ligule. **B.** Inflorescence. **C.** Glumes. **D.** Lemma. **E.** Spikelet. *Bromus porteri*. **F.** Habit. **G.** Collar. **H.** Spikelet. **I.** Lemma. **J.** Inflorescence. **K.** Ligule.

eastern Alaska to central Oregon (Pavlick & Anderton 2007). Pavlick & Anderton (2007) indicated that *B. pacificus* also occurs in northern California, based on two specimens from HSC identified as *B. pacificus* (M. Barkworth, pers. comm.). Examination of these specimens indicates that they were incorrectly determined [*Barker 1035* (HSC-44691!) from Del Norte Co. is *B. vulgaris*; and *Anderson 5120* (HSC-22840!) from Humboldt Co. is *B. carinatus* Hook. & Arn. var. *marginatus* (Nees) Barkworth & Anderton]. *Bromus pacificus* is not known from California (Saarela & Peterson, in press). In British Columbia, *B. pacificus* occurs in coastal regions of the province (Fig. 9B); absence of collections along much of the coastline likely reflects a paucity of collecting activities in difficult-to-access areas, rather than the absence of the species. Habitats include moist ravines, shaded woods, grassy swards, saline beaches, ditches and along roadsides. Elevation: 0–50 m.

Common Names.—Pacific brome, Shear Pacific brome.

Notes.—Many *B. pacificus* specimens from British Columbia have previously been determined incorrectly as species of *B.* sect. *Ceratochloa* (i.e., *B. carinatus* or *B. sitchensis*). With large, open panicles, *B. pacificus* is superficially similar to these taxa, but it can be easily distinguished from them by its lemmas that are rounded or slightly keeled over the back (vs. lemmas that are strongly laterally flattened and keeled in species of *B.* sect. *Ceratochloa*), and 1- and 3-nerved lower and upper glumes (vs. 3–5- and 5–9-nerved lower and upper glumes, respectively). Additionally, *B. pacificus* occurs only on or near the coast, whereas plants in *B.* sect. *Ceratochloa* are distributed much more widely.

Representative Specimens Examined. **CANADA. British Columbia:** Qualicum, Vancouver Island, 29 Jul 1887, *Macoun 30008* (CAN, US); Renfrew, 18 Jul 1902, *C.O. Rosendahl 776* (CAN, US); Sidney, Vancouver Island, 30 May 1914, *M.O. Malte s.n.*(DAO); Courtenay River, Comox, 10 Jul 1915, *J. Macoun s.n.* (V); Courtenay, 23 Jul 1915, *M.O. Malte 108338* (CAN, DAO); Alberni, Jul 1916, *W. R. Carter s.n.* (V); Prince Rupert, 1 Aug 1916, *M.O. Malte 106910* (CAN, DAO); Vancouver Island, Port Alberni, head of Alberni Canal, 18 Aug 1922, *J. Davidson s.n.* (UBC); Triangle Island, 28 Jun 1949, *G. Hardy 21645* (V); Queen Charlotte Islands, Moresby Island, Louscoone Inlet, 13 Sep 1951, *R. Pillsbury s.n.* (UBC); shore of Duncan Bay ca. 6 mi WNW of Prince Rupert, 24 Aug 1954, *J.A. Calder, D.B.O. Savile & J.M. Ferguson 14973* (DAO); Indian Village near Henslung Bay, Langara Island off NW tip of Graham Island, 16 Jul 1957, *J.A. Calder, D.B.O. Savile & R.L. Taylor22539* (DAO); near Juskatla on Juskatla Inlet, Graham Island, 8 Aug 1957, *D.B.O. Savile 3520* (DAO); Yakoun River Delta S of Port Clements, Masset Inlet, Graham Island, 15 Aug 1957, *J.A. Calder & R.L. Taylor 23507* (DAO); Queen Charlotte Islands, Deena River mouth, E entrance to Skidegate Channel, 27 Aug 1957, *J.A. Calder & R.L. Taylor 23789* (DAO, UBC); Markale, Kyuquot, 1 Jul 1958, *Taylor 143* (UBC); Kyuquot, Mckay cove, 8 Jul 1958, *Taylor 383* (UBC); Queen Charlotte Islands: Moresby Island, W end of S arm of Kootenay Inlet, 22 Jul 1964, *J.A. Calder & R.L. Taylor 36201* (DAO, UBC); Kaisum ancient Haida village, Moresby Island, 4 Aug 1964, *J.A. Calder & R.L. Taylor 36523* (DAO); Tee Island, E side of Naden Harbour, Graham Island, 12 Aug 1964, *J.A. Calder & R.L. Taylor 36848* (DAO); Long Island, Vancouver Island, 19 Aug 1965, *Taylor 6740* (UBC); W of Truck Narrows, Truck Inlet, ca. 7 mi N of Prince Rupert, range 5, Coast District, 31 Jul 1973, *V. Krajina s.n.* (UBC); Vancouver Island, Tofino, Meares Island, lake and creek S of Lone Creek, 1 Jul 1981, *A. Ceska, O. Oldriska, & R.T. Ogilvie s.n.* (UBC); Vancouver Island, Nitinat Camp, junction of Nitinat Camp Road & Cowichan, Nitinat Lake Road, 21 Aug 1989, *L.E. Pavlick 89-158* (UBC); Vancouver Island, Port Alberni, near mouth of Somass River, 11 Sep 1993, *J. Cayouette C7592* (DAO); Port Moody, Rocky Point Park at head of Burrard Inlet, about 14 km E of Vancouver, 5 Augut 1996, *F. Lomer 96-128* (UBC); Queen Charlotte Islands, Moresby Island, 11 km SE of Sandspit, Sheldens Lagoon, 0 m, 18 Jul 1997, *F. Lomer & N. Grove 97407* (V); mouth by Mission Creek, W edge of Kincolith (Ginglox), 22 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18719* (CAN, US); entrance to Ferry at Prince Rupert, 23 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18729* (CAN, US); Vancouver Island, Rupert Inlet, 4 Sep 2006, *J.M. Saarela 760* (CAN, UBC); Queen Charlotte Islands: Graham Island, Rennell Sound Recreation Site, at end of Rennell Sound Forest Service Road at Rennell Sound, ca. 36 km NW of Queen Charlotte City, 23 Jul 2007, *J.M. Saarela & D.M. Percy 1202* (CAN, UBC); Rainbow Pass, Coast Mountains, along Hwy 16, E of Prince Rupert, 26 Jul 2007, *J.M. Saarela & D.M. Percy 1308* (CAN, UBC); along Hwy 16, adjacent to Skeena River between Tyhee and Skeena, 26 Jul 2007, *J.M. Saarela & D.M. Percy 1311* (CAN, UBC).

9. Bromus porteri (J.M. Coult.) Nash, Bull. Torrey Bot. Club 22:512. 1895. (**Figs. 9C, 10F–K**). *Bromus kalmii* var. *porteri* J. M. Coult., Man. Bot. Rocky Mt. 425. 1885. *Bromus ciliatus* var. *porteri* (J. M. Coult.) Rydb., Contr. U.S. Natl. Herb. 3:192. 1895. *Bromopsis porteri* (J. M. Coult.) Holub, Folia Geobot. Phytotax. 8:168. 1973. Type: U.S.A. Colorado. Lake Co.: Twin Lakes, 25 Jul 1872, *T.C. Porter s.n* (lectotype: NY, designated by Wagnon, Brittonia 7:471. 1952).

Bromus ciliatus var. *montanus* Vasey ex Beal, Grass. N. Amer. 2:619. 1896. Type: U.S.A. Colorado: 1892, *H.N. Patterson 264* (lectotype: MSC, designated by Beal, Grass. N. Amer. 2:619. 1896; isolectotype: US–1008608!).

Bromus ciliatus var. *scariosus* Scribn., Bull. Div. Agrostol., U.S.D.A. 13:46. 1898. Type: U.S.A. Wyoming. Albany Co.: Sheep Mountain, 3 Jul 1897, *A. Nelson 3305* (holotype: US–1008288!).

Bromus kalmii var. *occidentalis* Vasey ex Beal, Grass. N. Amer. 2:624. 1896. Type: U.S.A. Montana: *Anderson 11* (lectotype: MSC-0091326!, designated here; isotype: US-865498!, fragment and photostat ex. MSC).

Notes: In the protologue for *B. kalmii* var. *occidentalis*, Beal (1896:624) lists three syntypes: (1) Montana, 1883, *W.M. Canby & F.L. Scribner 384*; (2) Montana, *Anderson 11*; (3) Colorado, *Cassidy s.n.* There is a sheet in US (US-1008517; digital photograph!) labeled "*B. ciliatus* or *B. kalmii* var. *occidentalis*" with the following collection information: *F.L. Scribner*, 1883, Northern Pacific R. R. [rail road]. The specimen is annotated in A.S. Hitchcock's hand "Probably Vasey's type of *Bromus kalmii occidentalis* Vasey; Beal's type probably in Herb. Mich. Agr. Coll." The specimen also bears the handwritten annotation "Montana probably." Hitchcock (1935:811) indicated that *Canby & Scribner 384* is the type. The Botanical Type Specimen Registry at the US National Herbarium identifies this as the *Canby & Scribner 384* specimen (http://ravenel.si.edu/botany/types, accessed 12 Jun 2007), but neither Canby's name, the collection number (384), nor the geographic provenance of the specimen (Montana) are indicated on the specimen; it is therefore not absolutely clear that this is the specimen cited in the protologue. Pavlick et al. (2003:172) erroneously indicated that the Canby and Scribner specimen is housed at both MSC and US; there are no sheets of this collection in MSC (*fide* L.A. Prather, 2007). The last two syntypes have been located at MSC (MSC-0091326! and MSC-0091327!), and there is a fragment and a photograph of the Anderson sheet at US (fragm. US-865498; digital photo!) that bears the annotation "*Anderson 11* ex MSC". Pavlick et al. (2003:172) erroneously indicate that this fragment and photograph are the Canby & Scribner collection. In accordance with Article 9.18 of the ICBN (Vienna Code), Hitchcock's choice of type is in conflict with the protologue, and there are other elements available that are are not in conflict with the protologue. Among the Anderson and Cassidy collections, the Anderson collection is most complete. It is most appropriate to designate the Anderson collection as the lectotype because it is a robust specimen and it is not in conflict with the protologue.

Perennial; rhizomes absent; plants 32–100 cm tall. Culms 0.7–1.8 mm wide at base, smooth, sometimes pubescent below inflorescence; nodes 3–8, brown, glabrous, sometimes with minute hairs below nodes; lower nodes covered by sheaths. Leaf sheaths closed for most of their length, glabrous; auricles absent; ligules 0.5–1.9 mm long, membranous, glabrous, erose; blades 7–28 cm long, 1.9–5 mm wide, adaxial surface glabrous, abaxial surface glabrous or with sparse, soft hairs to 1.5 mm, margins smooth or serrulate. Panicles 5–12 cm long, 1.5–7 cm wide, open; branches ascending to drooping, shorter or longer than spikelet, pubescent, 1–2 spikelets per branch, lowest inflorescence node with 1–2 branches. Spikelets 1.7–3.1 cm long, ovate-lanceolate, terete to slightly compressed, rachillas sometimes visible at maturity, particularly distally; florets 4–9. Glumes lanceolate, pubescent, hairs 0.2–0.3 mm long; lower glumes 5.2–7.5 mm long, (1–)3-nerved; upper glumes 6.2–9.5 mm long, 3-nerved. Lemmas 8–10 mm long, 1.5–2.5 mm wide, 7-nerved, densely pubescent with hairs 0.2–1.5 mm long, hairs sometimes denser on lower ½, apex entire or minutely bifid, the cleft 0–0.2 mm deep; awns 0.8–3.1 mm long, arising 0–0.3 mm below lemma apex, straight, antrorsely scabrous. Paleas 7–8.2 mm long, shorter than lemmas, keels ciliate, cilia to 0.3 mm long. Stamens 3; anthers 1.9–2.5 mm long, dark brown. $2n = 14$.

Distribution and Habitat.—Native. *Bromus porteri* occurs in southern Alberta, Saskatchewan and Manitoba and south to western Texas and California (Pavlick & Anderton 2007). In British Columbia *B. porteri* occurs mostly in the interior of the province. Habitat includes dry talus slopes, meadows, open ground, woodland flats and grasslands. Elevation: 152–1310 m.

Common Name. — nodding brome.

Notes.—*Bromus porteri* has been variously treated as a distinct species (e.g., Gould & Moran 1981; Pavlick 1995; Pavlick & Anderton 2007; Scoggan 1978; Soderstrom & Beaman 1968) or as a synonym of *Bromus anomalus* Rupr. ex E. Fourn. (e.g., Douglas et al. 2001; Wilken & Painter 1993). *Bromus anomalus* and *B. porteri* are morphologically and geographically distinct taxa. *Bromus anomalus* is easily separated from *B. porteri* by its 1-nerved lower glumes [vs. (1)3-nerved in *B. porteri*] and conspicuously narrowed midvein of the leaf below the collar (Wagnon 1952; Pavlick 1995; Pavlick & Anderton 2007; J. M. Saarela, personal observation). The two species are largely allopatric. *Bromus porteri* has a wide distribution in western North America where it is distributed from Manitoba to British Columbia and south to California, New Mexico and northeastern Mexico (Wagnon 1952; Pavlick 1995; Herrera Arrieta 2001; Pavlick & Anderton 2007; Saarela & Peterson in press), whereas *B. anomalus* is distributed in Texas and throughout northern and central Mexico (Soderstrom & Beaman 1968; Pavlick et al. 2003; Herrera Arrieta 2001; J. M. Saarela, personal observation). Plants in British Columbia are clearly referable to *Bromus porteri*.

Representative Specimens Examined. **CANADA. British Columbia:** Klinaklini Valley, 3000 ft, 17 Sep 1920, *T. MacKenzie 3-1* (UBC); junction of Banbricker and Big Creeks, Chilcotin, 16 Jul 1929, *J. Davidson 63* (UBC); Chilcotin (E), Riske Creek, 13 Aug 1938, *E.W. Tisdale 40-1* (US); Hanceville, Chilcotin, 24 Jul 1944, *J.W. Eastham 12236* (CAN, UBC); Francois Lake, 6 Jul 1944, *J.W. Eastham s.n.* (UBC); Canoe Creek, Gang Ranch road, 13 Jul 1945, *J.W. Eastham s.n.* (DAO, UBC); above Pavilion Lake, 30 Jul 1946, *V.C. Brink s.n.* (UBC); Old

Forestry Lookout, Ootsa Lake, 8 Jul 1944, *J.W. Eastham s.n.* (UBC); Hanceville, Chilcotin, 24 Jul 1944, *J.W. Eastham s.n.* (V); Cariboo zone, 1 mi S of Farwell Creek, 20 Jul 1967, *C. Beil 67-07-20* (UBC); Chilcotin, plot no. 105, 3500 ft, Aug 1968, *C. Beil 68-8-21* (UBC); Farwell Creek, 19 Jul 1972, *C.E. Beil 282* (UBC); W side of Relay Creek Basin trail ca. 1.5 mi from Relay Creek cabin, 27 Jul 1977, *C. Selby plot 78 #627* (UBC); Relay Creek Basin, 12 Aug 1977, *C. Selby s.n.* (UBC); Stikine River (Ranch), 500 ft, 9 Sep 1977, *A.A. Rose 77-771* (UBC); 0.3 km N of Burn Creek, 0.5 km from Stikine River, 744-824 m, 31 Jul 1979, *W. Gorman 1349* (UBC); 10 km W of Tatla Lake Village, 5 Jul 1980, *L.E. Pavlick 80-14* (V); Cariboo District, Riske Creek, E pasture of Bald Mountain, 12 Jul 1982, *S.G. Aiken, S.J. Darbyshiren & A. Roberts 2287* (DAO); Cariboo District, Alexis Creek, 1 km N of settlement, 17 Jul 1982, *S.G. Aiken & S.J. Darbyshire 2369* (DAO); Thompson-Okanagan, Cornwall Hills, along Cornwall Hills Road, 13 Sep 1989, *L.E. Pavlick 89-212* (UBC, V); Thompson-Okanagan, Hat Creek, along Hat Creek Road, 14 Sep 1989, *L.E. Pavlick 89-263* (UBC); Chasm, 26 Jul 1989, *F. Lomer 89-14* (UBC); Cariboo area, NW of Clinton, White Lake, 13 Sep 1993, *J. Cayouette C7601* (DAO); Cariboo-Chilcotin, Dog Creek area, 7 Jul 1994, *T. Goward & C. Clement 94-513* (UBC); Cariboo-Chilcotin, Dog Creek area, 21 Jul 1994, *T. Goward & C. Clement 94-594* (UBC); Peace River Land District, W of Fort St. John, close to road 29, 10 Sep 1998, *J. Cayouette 8491* (DAO).

10. Bromus pumpellianus Scribn., Bull. Torrey Bot. Club 15:9. 1888. (**Figs. 11A–E, 12A**). *Forasaccus pumpellianus* (Scribn.) Lunell, Amer. Midl. Naturalist 4:225. 1915. *Bromus inermis* subsp. *pumpellianus* (Scribn.) Wagnon, Rhodora 52:211. 1950. *Zerna pumpelliana* (Scribn.) Tzvelev, Fl. Arct. U.R.S.S. 2:225. 1964. *Bromopsis pumpelliana* (Scribn.) Holub, Folia Geobot. Phytotax. 8:168. 1973. Type: U.S.A. Montana. Meagher Co.: Belt Mountains, Meagher County, Montana, 1883, *F. Lamson-Scribner 418* (holotype: US-81590!).

Bromus purgans var. *purpurascens* Hook., Fl.-Bor. Amer. 2:252. 1840. *Bromus inermis* subsp. *pumpellianus* var. *purpurascens* (Hook.) Wagnon, Rhodora 52:211. 1950. Type: CANADA: Bear Lake to Arctic seacoast, *Richardson s.n.* (holotype: K; isotype: US–865455!, fragment ex K).

Bromus ciliatus var. *coloradensis* Vasey ex Beal, Grass. N. Amer. 2:619. 1896. Type: U.S.A. Colorado: near Gray's Peak, *Wolf 1158* (lectotype: US-1007969!, designated by Hitchcock, Man. Grass. U.S. 816. 1935).

Bromus pumpellianus var. *tweedyi* Scribn. ex Beal, Grass. N. Amer. 2:622. 1896. Type: U.S.A. Montana: Yellowstone Park, Slough Creek, 1885, *F. Tweedy 587* (isotype: US–81592!).

Bromus arcticus Shear in Scribn. & Merr., Contr. U.S. Natl. Herb. 13:83. 1910. *Bromus pumpellianus* var. *arcticus* (Shear) Porsild, Rhodora 41:182. 1939. Type: U.S.A. Alaska: 9 Sep 1901, *F.A. Walpole 2036* (holotype: US–379157!, with the following additional location information: "Vicinity of Port Clarence. Tundra banks near buildings at Teller Reindeer Station").

Perennial; rhizomes present; basal leaves readily decaying into straight fibres. Culms 3.2–4.5 mm wide at base, ± densely pubescent below nodes; nodes 2–3, light brown-yellow, moderately to densely pubescent, hairs to 1 mm long. Leaf sheaths closed for most of their length, glabrous or pilose with long, soft hairs to 2 mm long; auricles present or absent; ligules 1–4 mm long, membranous, glabrous, erose; blades 9–17 cm long, 2.1–10 mm wide, adaxial surfaces glabrous or pubescent with dense, short hairs to 0.5 mm long, abaxial surfaces glabrous or variously pubescent with hairs 0.5–1.2 mm long, hairs sometimes present only marginally, margins serrulate. Panicles 10–29.5 cm long, 1.5–14.5 cm wide, open, branches erect to ascending, shorter or longer than spikelet, scabrous, 1(–2) spikelets per branch, lowest inflorescence node with 4 branches. Spikelets 2.3–3.3 cm long (including awns); florets 7–14. Glumes subequal, lanceolate, glabrous, midnerves scabrous; lower glumes 6.5–10 mm long, 1-nerved; upper glumes 9–12.8 mm long, 3-nerved. Lemmas 10–13 mm long, 1.5–2.6 mm wide, variously pubescent with hairs 0.5–0.8 mm long along margins and midvein or moderately to densely villous throughout; awns 1–4.5(–5) mm long, arising 0–0.5 mm below lemma apex, straight, antrorsely scabrous. Paleas 9.2–11 mm long, shorter than lemmas, cilia present on keels along lower ¾ to entire length, cilia ca. 0.2 mm long. Stamens 3; anthers 4.1–6.5 mm long, yellow to dark brown. $2n = 56$.

Distribution and Habitat.—Native. *Bromus pumpellianus* occurs in western North America from Alaska to New Mexico and west through south-central Alberta, Sasakatchewan and Manitoba to northern Ontario (Pavlick & Anderton 2007). In British Columbia *B. pumpellianus* occurs in the Rocky Mountains (Fig. 12A). Habitat includes grassy banks, grassy meadows, wet banks, sand and gravel bars along rivers and roadsides. Elevation: 597–2000 m.

Common Name.—pumpelly brome.

Notes.—*Bromus pumpellianus* is a morphologically variable taxon. In North America, some authors have treated it as a subspecies or variety of the morphologically similar and putatively closely-related taxon *Bromus inermis* (e.g., Elliott 1949; Wagnon 1952; Scoggan 1978). Several intraspecific taxa have been recognized

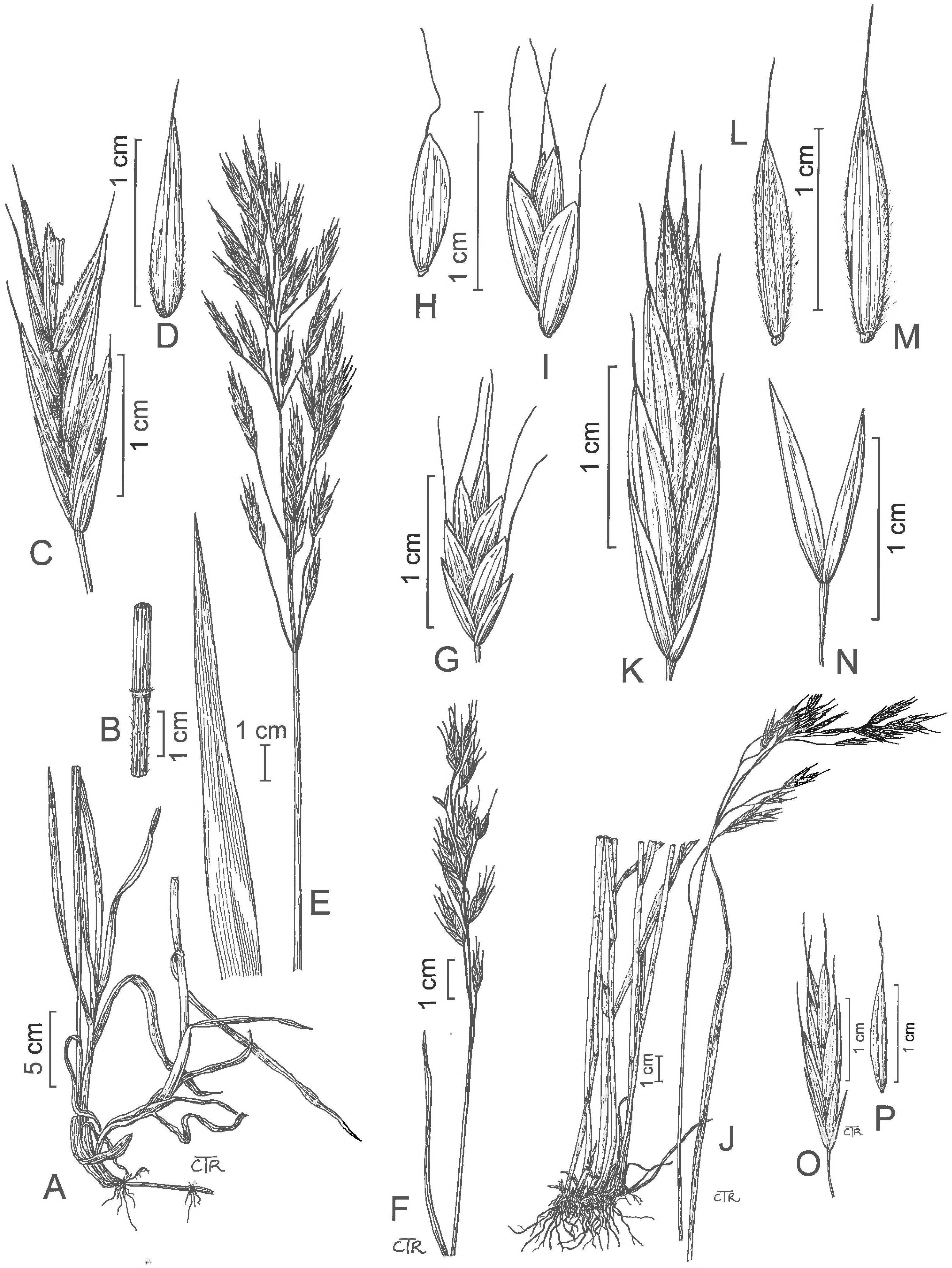

Fig. 11. *Bromus pumpellianus*. A. Rhizome. B. Node. C. Spikelet. D. Lemma. E. Inflorescence. *Bromus racemosus*. F. Inflorescence. G. Spikelet. H, I. Lemmas. *Bromus richardsonii*. J. Inflorescence. K. Spikelet. L, M. Lemmas. N. Glumes. *Bromus riparius*. O. Spikelet. P. Lemma.

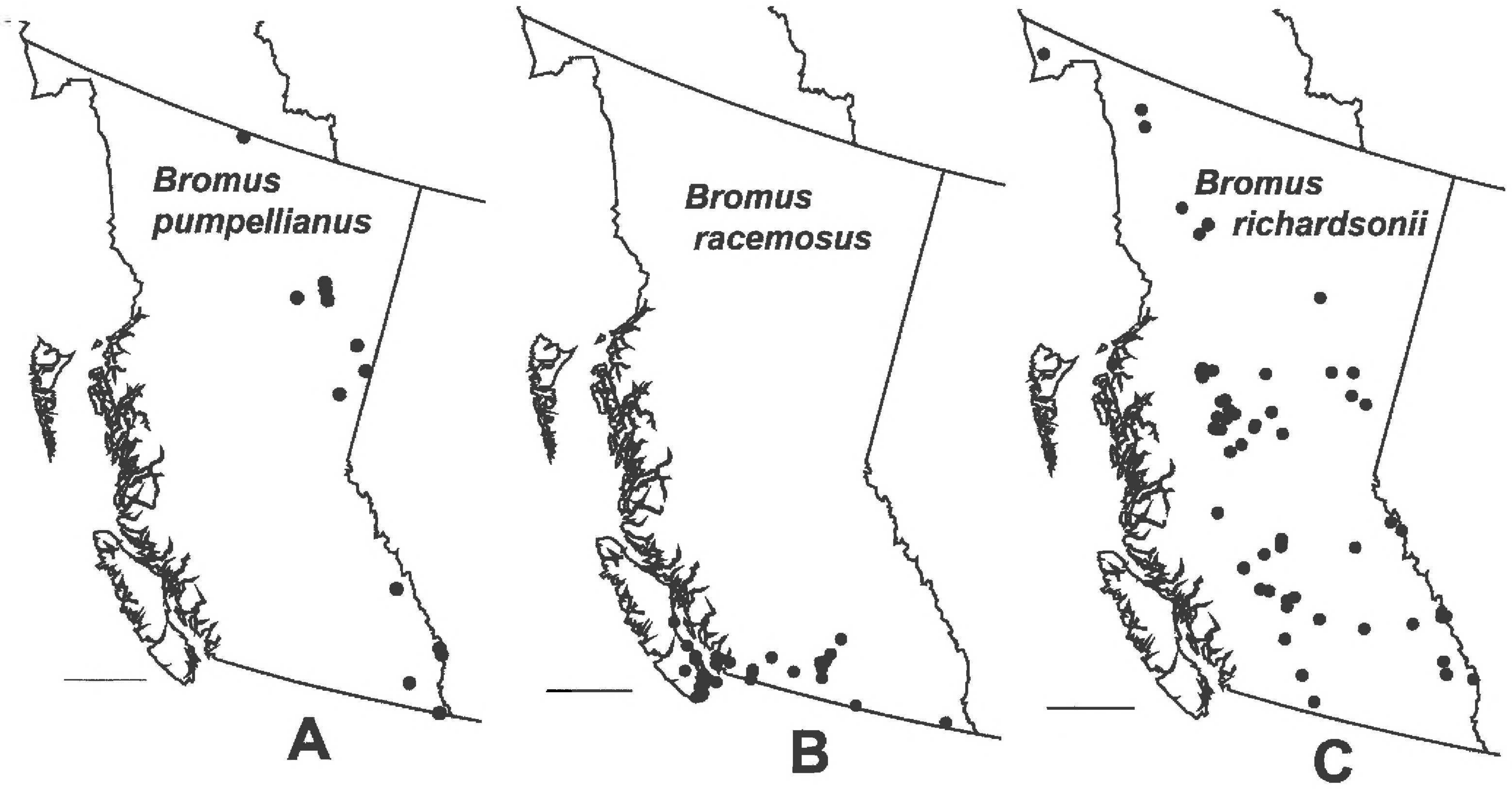

Fig. 12. Geographic distribution in British Columbia. A. *Bromus pumpellianus*. B. *Bromus racemosus*. C. *Bromus richardsonii*. Scale bars = 200 km.

within *B. pumpellianus* based on degree of spikelet pubescence [e.g., var. *arcticus* (Shear) Porsild, var. *purpurascens* (Hook.) Wagnon] but there is substantial intergradation among these types and recent authors do not recognize them (e.g., Mitchell 1967; Pavlick 1995; Douglas et al. 2001; Pavlick & Anderton 2007). *Bromus pumpellianus* is also morphologically similar to the introduced *B. riparius* (see discussion under that taxon).

Representative Specimens Examined. **CANADA. British Columbia:** Moberly, 14 Jul 1930, *R. Graham s.n.* (UBC); vicinity of Sikanni River, 21 Jun 1943, *H.M. Raup & D.S. Correll 10223* (UBC); Perry Creek, Cranbrook (Selkirks), 8 Aug 1943, *J.W. Eastham 11035* (UBC); vicinity of Buckinghorse River, 1 Sep 1943, *H.M. Raup & D.S. Correll 11619* (CAN, UBC); Fort St. John, 23 Jun 1948, *n.c.* (DAO); Ft. St. John, 29 Jun 1949, *V.C. Brink s.n.* (UBC); Mile 98, Haines Road, 7 Jul 1956, *T M.C. Taylor, A.F. Szczawinski & M. Bell 1015* (DAO, UBC), *984* (DAO, UBC), *1035* (DAO); Mile 14, Flathead Rd, 15 Jul 1957, *M. Bell & J. Davidson s.n.* (UBC); Sage Creek Lodge, 21 Jul 1957, *M. Bell & J. Davidson s.n.* (UBC); U.S. Border, Flathead, 4600 ft, 27 Jul 1957, *M. Bell & J. Davidson 599* (UBC); U.S. Border, Flathead, 4600 ft, 27 Jul 1957, *J.W. Eastham 599* (DAO); junction of Goat (Boivin) Creek and Elk River, 4200 ft, 30 Jun 1958, *R.L. Taylor & D.H. Ferguson 2264* (DAO); W of Hyland River at Mile 160, 5 Jul 1960, *J.A. Calder & J.M. Gillett 26541* (DAO); 4 mi NW of Dawson Creek along highway to Ft. St. John, 12 Jul 1960, *J.A. Calder & I. Kukkonen 26820* (DAO); Nevis Creek, 17 Jul 1969, *A. Luckhurst s.n.* (UBC); Nevis Creek, 24 Jul 1969, *A. Luckhurst s.n.* (UBC); Mt Turnbull, Fording River, Creek 4, 29 Sep 1970, *D.C. Morrison s.n.* (UBC); Mt Turnbull, plot 6, Fording River, 28 Jul 1971, *D.C. Morrison s.n.* (UBC); Emkay, Bleasdell Mt, 10 Aug 1972, *n.c.* (UBC); intersection of Ewart Creek and Ashnola River, 9.8.1975, *R. Hainault 7713* (DAO); Robb Lake, slopes on N side of lake, 3900 ft, 29 Jul 1977, *G.W. Argus & E. Haber 10197* (CAN); summit of Pink mountain, 10 Aug 1992, *F. Lomer 92-160* (UBC).

11. Bromus racemosus L., Sp. Pl., ed. 2. 1:114. 1762. (**Fig. 11F–I, 12B**). *Serrafalcus racemosus* (L.) Parl., Rar. Pl. Sic. 2:14. 1840. *Bromus arvensis* var. *racemosus* (L.) Neilreich, Fl. Nieder-Oesterr. 81. 1859. *B. squarrosus* var. *racemosus* (L.) Regel, Act. Hort. Petrop. 7:602. 1881. *Bromus mollis* var. *racemosus* (L.) Bubani, Fl. Pyr 4:387. 1901. *Bromus hordeaceus* var. *racemosus* (L.) Fiori, Nuova Fl. Analitica Ital. 1:149. 1923. Type: *Anon* (lectotype: LINN 93.31, designated by Smith, Notes Roy. Bot. Gard. Edinb. 42:499. 1985).

Annual; rhizomes absent; plants 17–60 tall. Culms 1–2.1 mm wide at base, smooth; nodes 2–3, brown, minutely to densely pubescent, hairs to 0.6 mm long. Leaf sheaths closed for most of their length, densely pubescent, hairs soft and wavy to 1.2 mm long; auricles absent; ligules 0.5–2 mm long, membranous, glabrous, erose; blades 2.7–12 cm long, 1–3 mm wide, adaxial surface densely pubescent with stiff hairs to 0. 8 mm long, abaxial surface densely pubescent with shorter, stiff hairs to 0.6 mm long or like adaxial surface, margins smooth or serrulate. Panicles 3–8.5 cm long (or less when reduced to a single spikelet), 1–2.5 cm wide, longest lower branch < 4 cm long (as measured from node to apex of terminal floret, including awn); branches erect to ascending, sometimes secund, scabrous to pubescent, 1 spikelet per branch, lowest inflorescence node with 1–4 branches. Spikelets 1.5–2.2(–2.6) cm long (including awns), ovate-lanceolate, rachilla sometimes visible at maturity, florets 6–9. Glumes slightly subequal, smooth or scabrous, keels occasionally serrulate distally; lower glumes 5.2–6.7 mm long, 3–5-nerved; upper glumes 6.2–8.5 mm long, 7–9-nerved. Lemmas 6.5–9.5 mm long, 1.5–2 mm wide, 7–9-nerved, nerves visible but not conspicuously raised, backs glabrous or scabrous to puberulent, hairs to 0.5 mm long, margins ± bluntly angled, apex entire or minutely bifid, the cleft 0.1–0.2 mm deep; awns 3.4–8.5 mm long, arising < 1.5 mm below lemma apex, straight or minutely divaricate, antrorsely scabrous, awns of lowest florets shorter than others. Paleas 5.5-8.5 mm long, shorter than lemmas, backs glabrous, keels ciliate, cilia to 0.3 mm long. Stamens 2; anthers (0.5)1–1.6 mm long, dark brown. $2n = 28$.

Distribution and Habitat.—Introduced. In North America, *B. racemosus* occurs in scattered locations across the U.S.A. and southern Canada (Pavlick & Anderton 2007). In British Columbia *B. racemosus* occurs mostly in the southwestern and southcentral parts of the province (Fig. 12B). Habitats include waste places, field, roadsides and gravelly hillsides. Elevation: 0–967 m.

Common Names.—bald brome, meadow brome, smooth brome, smooth chess.

Notes.—*Bromus racemosus* is often confused with *Bromus hordeaceus* because both taxa have relatively narrow inflorescences, and the two have sometimes been treated as synonyms (e.g., Wilken and Painter 1993). *Bromus hordeaceus* is distinguished by its lemmas with conspicuously raised nerves and generally denser inflorescences. See additional comments under *B. commutatus* and *B. hordeaceus*.

Representative Specimens Examined. **CANADA. British Columbia:** near Victoria, 7 May 1875, *Macoun 29980* (CAN); near Victoria, Aug 1876, *Dawson 29979* (CAN); Nanaimo, 4 Jun 1884, *J. Macoun 29982* (US); Pitt River, Aug 1884, *Macoun 29981* (CAN); Vancouver, 23 Jun 1887, *J. Fowler s.n.* (US); Yale, *Macoun (90)29988* (CAN); Spence's Bridge, 28 May 1889, *Macoun (92)* (CAN); Victoria area, 27 May 1893, *Macoun 116* (CAN); Victoria, 8 Jul 1893, *Wm. Scott s.n.* (DAO); Nanaimo, 20 Jun 1907, *C.O. Rosendahl 1887* (US); vicinity of Victoria, 6 Jun 1908, *J. Macoun 76851* (CAN, US); Robertson River, Vancouver Island, 5 Jul 1911, *W. Spreadborough 87602* (US); vicinity of Sidney, 16 Jun 1913, *J. Macoun 88542* (CAN); Saltspring Island, 24 May 1914, *J.M. Macoun 90094* (CAN); 10th Ave and Willow St., Vancouver, Jun 1918, *J. Davidson s.n.* (UBC); Vernon, 16 Jun 1918, *A.H. Hutchinson s.n.* (UBC); Vernon, 25 Jun 1917, *E.M. Warren s.n.* (UBC); Vernon, 17 Jun 1918, *A.H. Hutchinson s.n.* (UBC); Victoria, Jun 1920, *G.V. Copley 1-15* (UBC); Courtenay, 3 Oct 1930, *H. Groh s.n.* (DAO); Steveston, 20 May 1931, *H. Groh s.n.* (DAO); Saanichton, 27 May 1931, *H. Groh s.n.* (DAO); Ganges, 28 May 1931, *H. Groh s.n.* (DAO); W Point Grey, 14 Jun 1934, *J.W. Eastham s.n.* (UBC); W Point Grey, Vancouver, 20 Jun 1937, *J.W. Eastham s.n.* (UBC); Fairfield Island, Chilliwack, 10 Jun 1946, *J.W. Eastham s.n.* (UBC); Fairfield Island, Chilliwack, 18 Jun 1946, *J.W. Eastham 15133* (DAO); Christina Lake, 29 May 1953, *G.H. Collin s.n.* (DAO); along highway on W side of Skaha Lake between Penticton and Kaleden, 28 Jun 1953, *J.A. Calder & D.B.O. Savile 9784* (US); Christina Lake, 14 Jul 1953, *J.M. Smith s.n.* (DAO); Christina Lake, 31 May 1954, *W.G. Dore & M. Smith s.n.* (DAO); Christina Lake, near Grand Forks, 31 May 1954, *W.G. Dore 15053* (DAO); Parksville, 13 Jul 1954, *T.M.C. Taylor 3086* (UBC); 7 mi N of Duncan, 18 May 1955, *D.R. Lindsay & W. Woodbury 696* (DAO); S Pender Island, 11 Jul 1955, *S. Buchanan s.n.* (UBC); Saltspring Island, 12 Jun 1955, *T.R. Ashlee s.n.* (UBC); Summerland Research Station, 1300 ft, 14 Jul 1960, *A. Mclean 60-83* (DAO); John Dean Park, Saanichton, 1000 ft, 14 Jun 1962, *J. Hett s.n.* (DAO); Henderson Point, W coast of Saanich Peninsula, 14 May 1962, *J. Hett s.n.* (DAO); Uplands Park, Victoria, 15 Jun 1962, *J. Hett 62* (DAO); Gordon Head, Victoria, 19 May 1962, *M. Bell s.n.* (DAO); Beechy Head, 10 ft, 4 Jun 1965, *A. Fisk & B.W. Davies 803* (DAO); Albert Head near Victoria, 30 May 1962, *J. Hett s.n.* (DAO); North Hill, Saanich, 350 ft, 2 Jun 1965, *B.W. Davies & R.A. Keller 752* (DAO); S Kelowna, 14 Jun 1970, *S. Kojima s.n.* (UBC); above Harrison River, 400 ft, 12 Jun 1974, *K.I. Beamish, J. Pinder-Moss, C. Selby, J. Pojar & E. Perkins 74063* (DAO); Patricia Bay Highway, one-half mile N of Royal Oak Corner, 20 May 1955, *D.R. Lindsay & W. Woodbury 754* (DAO); summit of Mount Bruce, S end of Saltspring Island, 3 Jul 1988, *S.J. Darbyshire & J.A. Darbyshire 3777* (CAN); alongside parking lot at UBC Museum of Anthropology, 25 May 05, *J.M. Saarela 305* (CAN, UBC); Rocky Mountain Forest District, along Hwy 3, 1.5 km E of Elko, 23 May 2006, *J.M. Saarela 405A* (CAN, UBC); Osoyoos, Haynes Provincial Park, 25 May 2006, *J.M. Saarela 484* (CAN, UBC); 10 km W of Princeton on Hwy 3, 19 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 586A* (CAN, UBC); ca. 2 km N of Garnet Lake, 14.6 km N on Garnet Valley Road from Hwy 97 at Summerland, 21 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 707* (CAN, UBC).

12. Bromus richardsonii Link, Hort. Berol. 2:281. 1833. (**Fig. 11J–M, 12C**). *Zerna richardsonii* (Link) Nevski, Trudy Sredne-Aziatsk. Gosud. Univ., Ser. 8b, Bot. 17:17. 1934. *Bromus ciliatus* var. *richardsonii* (Link) B. Boivin, Naturaliste Canad. (Que.) 94:521. 1967. *Zerna canadensis* subsp. *richardsonii* (Link) Tzvelev, Novosti Sist. Vyss. Rast. 7:54. 1970 [1971]. *Bromopsis richardsonii* (Link) Holub, Folia Geobot. Phytotax. 8(2):168. 1973. *Bromopsis canadensis* subsp. *richardsonii* (Link) Tzvelev, Zlaki SSSR 214. 1976. Type: Hab. in America septentrionali occidentali. Semina mist cl.: Grown from seed in Berlin, *Richardson s.n.* (holotype: B, destroyed *fide* J. Cayouette & P.M. Peterson 2007).

Bromus purgans var. *longispicatus* Hook., Fl. Bor.-Amer. 2:252. 1840. Type: CANADA: Rocky Mountains, *Drummond s.n.* (isotype: US-A865460!, fragment). Note: Pavlick et al. (2003) included this taxon as a synonym of *B. ciliatus*, but the fragment at US is clearly *B. richardsonii*, on the basis of its glume length and lemma pubescence.

Perennial; rhizomes absent; plants 47–110 cm tall. Culms 1.5–3.5 mm wide at base, smooth; nodes 3–4, brown, glabrous, lower nodes sometimes minutely pubescent. Leaf sheaths closed for most of their length, glabrous or sparsely to densely pilose with stiff hairs 0.2–1.2 mm long; auricles absent; ligules 1–2.5 mm long, membranous, glabrous or minutely pubescent, erose; blades 18.5–34 cm long, 3–9(–13) mm wide, adaxial and abaxial surfaces glabrous, margins smooth or serrulate. Panicles 13–23.5 cm long, 2–17.5 cm wide, open, branches ascending to drooping, shorter or longer than spikelet, smooth-scabrous, 1–5 spikelets per branch, lowest inflorescence node with 1–4 branches. Spikelets 2.4–3.5 cm long, rachilla sometimes visible at maturity; florets 3–9. Glumes subequal, lanceolate, glabrous or minutely pubescent, hairs sometimes restricted to margins, keels glabrous or scabrous; lower glumes 7–9.5(–12) mm long, 1(–3)-nerved, lanceolate; upper glumes (8–)9.5–11.5(–14.5) mm long, 3-nerved, sometimes acuminate or mucronate with mucros to 0.7(–1) mm long. Lemmas 9–13.5(–15) mm long, 2–2.8 mm wide, 7-nerved, pubescent, hairs along margins 0.2–1 mm long, hairs sparsely or densely scattered across the back > 0.1 mm long, apex entire or minutely bifid, the cleft to 0.2 mm long; awns 3.1–6.5 mm long, arising 0–0.5 mm below lemma apex, straight, antrorsely scabrous. Paleas 11–12 mm long, shorter than lemmas, keels glabrous or ciliate, cilia to 0.2 mm long. Stamens 3; anthers 1–2.6(–3.4) mm long, dark brown. $2n = 28$.

Distribution and Habitat.—Native. *Bromus richardsonii* is generally distributed west of the continental divide from the Yukon territory to central Mexico, with disjunct populations known from the Cypress Hills in southern Alberta/Saskatchewan, the Black Hills in South Dakota and western Texas (Peterson et al. 2002; Pavlick & Anderton 2007). *Bromus richardsonii* occurs throughout British Columbia east of the coastal mountain ranges (Fig. 12C). Its distribution is sympatric with that of *B. ciliatus* (Fig. 3B), but *B. richardsonii* generally occurs at higher elevations (Peterson et al. 2002). Habitats include meadows, open woods and gravelly areas. Elevation: 289–2133 m.

Common Name.—Richardson's brome.

Notes.—*Bromus richardsonii* has been variously recognized as a distinct species (Shear 1900; Hitchcock 1913; Wagnon 1952; Mitchell & Wilton 1965; Mitchell 1967; Hultén 1968; Welsh 1974; Pavlick 1995; Herrera Arrieta 2001; Peterson et al. 2002; Saarela et al. 2005; Pavlick & Anderton 2007; Saarela and Peterson, in press), as a synonym of *B. ciliatus* (e.g., Allred 1993; Hitchcock 1951; Soderstrom & Beaman 1968; Wilken & Painter 1993; Douglas et al. 2001) or as a variety of *B. ciliatus* (e.g., Kartesz 1999). In a detailed study of the complex, Peterson et al. (2002) identified distinctive morphological, cytological and genetic differences that support recognition of these taxa as distinct species (see Taxonomic Key).

Representative Specimens Examined. **CANADA. British Columbia:** Sicamous, 3 Jul 1889, *Macoun 30013* (CAN); below Wapta Lake, Rocky Mts, 6 Aug 1904, *Macoun 64804* (CAN); Field, Rocky Mountains, 19 Aug 1904, *Macoun 64803* (CAN); Sicamous, 16 Jul 1914, *M. Malte s.n.* (CAN, DAO); near Bow River, Field, 1-2 Aug 1914, *A. S. Hitchcock 11537* (US); Field, 2 Aug 1914, *A.S. Hitchcock s.n.* (DAO); E of Field, 1-2 Aug 1914, *A.S. Hitchcock 11,552* (US); Sinclair Hot Springs, 2 Aug 1915, *M.O. Malte s.n.* (CAN, DAO); Prince Rupert, 1 Aug 1916, *M.O. Malte s.n.* (CAN); W and NW slopes of Mt Selwyn, 4000 ft, 26 Jul 1932, *H.M. Raup & E.C. Abbe 4160* (CAN); Burns Lake, 5 Jul 1935, *O.J. Murie 2588* (US); Watching Creek, Tranquille, 8 Jul 1936, *E.W. Tisdale 6902* (DAO, UBC); Telkwa, 30 Jul 1937, *J.D. Menzies s.n.* (UBC); Callanah Lake, Riske Creek, Chilcotin, 14 Aug 1938, *H.A. Senn 1941* (UBC); Fairmont Hot Springs, 16 Jul 1941, *J.W. Eastham s.n.* (UBC, V); Mt Stephen area, Yoho National Park, 1 Aug 1943, *W.C. McCalla 7807* (UBC); valley of Kicking Horse River, 3 mi E of Field, 14 Sep 1943, *G.H. Turner 3833* (DAO); Fort St. James, 3 Jul 1944, *J.W. Eastham s.n.* (UBC); Ootsa Lake P.O., 8 Jul 1944, *J.W. Eastham s.n.* (UBC); Burns Lake, 16 Jul 1944, *J.W. Eastham s.n.* (CAN, UBC, V); Canoe Creek, Clinton area, 8 Aug 1946, *C. Rogers 35* (DAO); Pavilion Lake, 29 Aug 1949, *V.C. Brink 49-470* (UBC); ca. 5 mi on Gibson Pass rd to Paddy Lake, Manning Park, 28 Jul 1960, *A. McLean s.n.* [60-203?] (DAO); Chilcotin, plot no. 90, 3650 ft, Jul 1968, *C. Beil 68-7-17* (UBC); Chilcotin, plot no. 110, Aug 1968, *C. Beil 68-8-19* (UBC); area of 10 mile Carbon Creek, 18 Aug 1971, *n.c.* (UBC); Emkay, Bleasdell Mt, 10 Aug 1972, *n.c.* (UBC); near Fraser Lake, NW of Drywilliam Lake, 2450 ft, 10 Aug 1973, *V.J. Krajina & R. Revel s.n.* (UBC); ridge, 1.5 mi SE of Tyhee Lake, 2300 ft, 14 Jul 1974, *V.J. Krajina, J. Pojar & C. Parsons s.n.* (UBC); Ashnola Road, mile 24, 29 Jul 1975, *R. Hainault 7630* (DAO); Driftwood Creek, ca. 7 mi ENE of Smithers, 2400 ft, 17 Jul 1974, *V.J. Krajina, J. Pojar & C. Parsons s.n.* (DAO, UBC); Driftwood Canyon and Smithers, 19 Jul 1974, *J. Pojar J.92* (UBC); above Salix Creek, vicinity of mouth of Cow Parsnip Creek, Gladys Lake area, 4700 ft, 3 Aug 1975, *J. Pojar s.n.* (UBC); W entrance to Sanctuary Pass, Gladys Lake area, 5000 ft, 19 Aug 1975, *J. Pojar s.n.* (UBC); ca. 1 mi E of Relay Creek Cabin, 18 Jul 1977, *C. Selby plot 35 #399* (UBC); White Horse Bluffs area, S of Wells Gray Park, 25 Jul 1979, *T. Goward 81-375* (DAO); Bissett Creek, 10 km SW of Chetwynd, 610 m, 3 Aug 1979, *L.E. Pavlick 79-779* (V); Stones Bay Road, 7 km from Post Office, Fort St. James, 13 Jul 1981, *A. Kruckeberg 101* (UBC); Beece Creek area, 1510 m, 10 Aug 1981, *L.E. Pavlick 81-113* (V); Chilcotin area, Big Creek – Farwell Canyon road, near Big Creek, 14 Sep 1993, *J. Cayouette 7620* (DAO); Chilcotin Mts, Taseko Lake area, close to Beece Creek, 15 Sep 1993, *J. Cayouette*

7621 (DAO); Road 5A, 1 km N of Borgeson Lake, 16 Sep 1993, *J. Cayouette 7622* (DAO); Pope Mountain, near Ft. St. James, 792 m, 19 Jul 1996, *J.L. Penny & Botany BC 1996* (UBC); 13 mi SW of Clinton just past Kelly Lake, 26 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18740* (CAN, US); 1 mi S of Iskut on Hwy 37 towards Meziadin Junction, along Coyote Creek, 20 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18675* (CAN, US); Skihist Provinical Park, Hwy 8, ca. 10 km from Lytton, 22 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 728* (CAN, UBC); 5.5 km along North Shore Road (Stella Road), N of Hwy 16, just W of Nadleh Whuten Band First Nation Reserve boundary, N of Fraser Lake, 18 Jul 2007, *J.M. Saarela & D.M. Percy 1068* (CAN, UBC); along Jeanine Road, N shore of Fraser Lake, ca. 100 km W of Prince George, along dirt road 12 km W of Nadleh Whuten Band First Nation reserve, area known locally as "Red Beach", 18 Jul 2007, *J.M. Saarela & D.M. Percy 1083* (CAN, UBC); old gravel mining area, just S of Hwy 16, N of Bulkley River, just E of Ross Lake, 19 Jul 2007, *J.M. Saarela & D.M. Percy 1089* (CAN, UBC).

13. Bromus riparius Rehm., Notiz. Veg. Gest. Schwartz Meer 83. 1872. (**Figs. 11O–P, 13A**). *Zerna riparia* (Rehm.) Nevski in Acta Univ. Asiae Med. Ser. 8b, Bot. 17:17. 1934. *Bromopsis riparia* (Rehm.) Holub, Folia Geobot. Phytotax. 8:169. 1973. *B. biebersteinii* auct. Am., *non* Roem. & Schult. Type: RUSSIA: *Rehmann s.n.* (isotype: LE).

Perennial; caespitose with short rhizomes; decaying basal leaves reticulate-fibrillose, plants 34–120 cm tall. Culms 2.8–6 mm wide at base, smooth; nodes (2–)3–4, brown, smooth or pubescent with hairs 0.2–0.5 mm long. Leaf sheaths closed for most of their length, glabrous to moderately pubescent with soft, wavy hairs to 0.5–1.6 mm long; auricles absent; ligules 1.1–3 mm long, membranous, glabrous, erose; blades 11.5–32 cm long, 2–6.5 mm wide, adaxial surfaces glabrous or sparsely to densely pilose with hairs 0.5–2.5 mm long, abaxial surfaces pubescent with short hairs 0.3–0.5 mm long or longer hairs to 2 mm long, margins with robust, stiff hairs to 2.5 mm long that are widest at the base. Panicles 5.5–23 cm long, 1.5–10 cm wide, open, branches erect to ascending, branches shorter or longer than spikelet, scabrous, 1–3 spikelets per branch, lowest inflorescence node with (1)2–3 branches. Spikelets 1.9–3.6 cm long (including awns); florets 4–10. Glumes subequal, lanceolate, glabrous or sometimes pubescent with hairs to 0.7 mm long, hairs sometimes restricted to nerves; lower glumes 6–9.7 mm long, 1-nerved; upper glumes 7.5–11 mm long, 3-nerved. Lemmas 11–13 mm long, 1.3–1.6 mm wide, glabrous or pubescent throughout or marginally, hairs to 0.5(–1) mm long, midribs scabrous distally; awns 3.5–7.1 mm long, arising 0–1 mm below lemma apex, straight, antrorsely scabrous. Paleas 9–9.6 mm long, shorter than lemmas; keels ciliate along upper half to 2/3 of their length, the cilia 0.1–0.2 mm long. Stamens 3; anthers (3–)4–5.7 mm long; dark brown to orange. $2n = 70$.

Distribution and Habitat.—Introduced. Grassy meadows, pastures. *Bromus riparius* is known only from a single collection along Highway 3 in southeastern British Columbia (Fig. 13A). It is promoted in western North America for forage, but its precise distribution is not clear (Pavlick & Anderton 2007). See additional notes below.

Common Name.—English: meadow brome; French: brome des prés.

Notes.—Meadow brome (*Bromus riparius*) is native to southeastern Europe, Turkey, the Caucasus and central Asia. It was introduced into North America in the last century as a potential forage crop. A cultivar ('Regar') selected from material collected in Turkey was registered in the United States in 1966 and in Canada in 1980 (de Araújo & Coulman 2004). *Bromus riparius* is now promoted and grown widely for forage across western Canada and in adjacent regions of the U.S.A. There is substantial interest in this grass in the agronomic community and several cultivars ('Fleet', 'Paddock', 'Cash' and 'Montana') have recently been developed (Knowles 1990a, b; Cash et al. 2002; Jensen et al. 2004). From its first release, the name applied (incorrectly) to meadow brome in the United States was *B. biebersteinii* Roem. & Schult., a name that is still widely used in many government agronomy publications and in the seed trade. *Bromus biebersteinii* is a morphologically distinct Eurasian species (Tzvelev 1976) that is not reported for North America.

Bromus riparius is morphologically similar and closely related (Saarela et al. 2007) to *B. inermis* (smooth brome; see above), another introduced species widely used for forage and hay, which is seriously invasive in native plant communities (Otfinowski et al. 2007). Smooth bromegrass is widely grown because it is drought-tolerant and sod-forming, but it has slow regrowth characteristics and is considered better suited for use as hay. Meadow brome has better re-growth characteristics and is thus considered better suited for forage in pasture conditions (e.g., Thompson et al. 2003). Several reports indicate that *B. riparius* is less

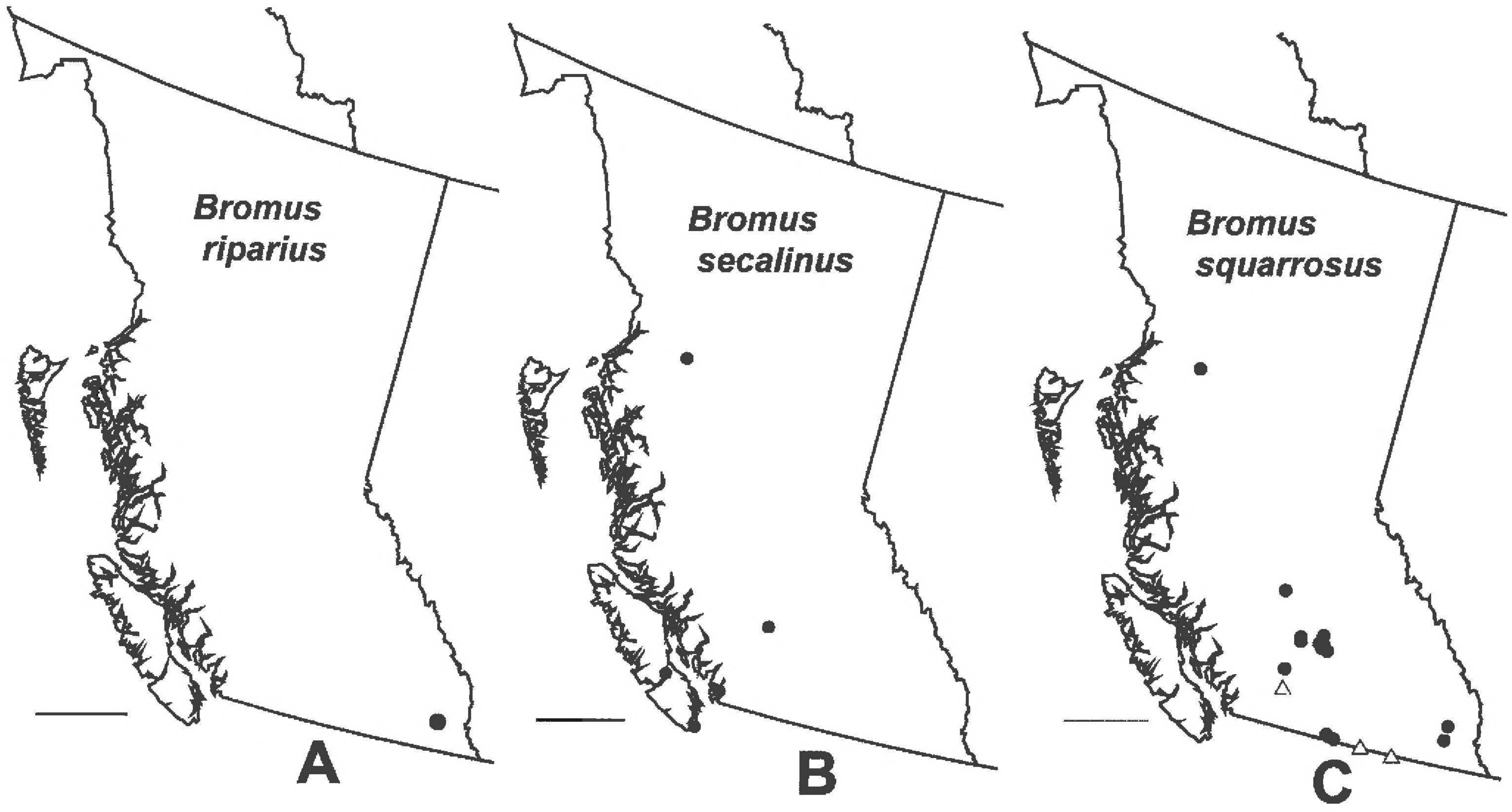

FIG. 13. Geographic distribution in British Columbia. A. *Bromus riparius*. B. *Bromus secalinus*. C. Circles: *Bromus squarrosus* var. *squarrosus*; triangles: *Bromus squarrosus* var. *villosus*. Scale bars = 200 km.

aggressive than *B. inermis* and not invasive (Anonymous 2000; de Araújo 2001; Ogle et al. 2004). Through breeding efforts, two hybrid bromegrasses have been developed and selected by Agriculture and Agri-Food Canada: one originating from a cross between *B. inermis* and *B. riparius* ('Knowles'; Coulman 2004), the other originating from a *B. inermis* × *B. riparius* hybrid backcrossed with *B. inermis* ('Success'; Coulman 2006). These hybrids combine characteristics of each of their parents; they are considered suitable for use as both hay and pasture (Knowles & Baron 1990; Knowles et al. 1993; Coulman 2004, 2006). Because of their agricultural importance, numerous aspects of morphology, forage quality and genetic diversity have been characterized in *B. inermis*, *B. riparius*, and their hybrids (e.g., Ferdinandez and Coulman 2000, 2001, 2002; Ferdinandez et al. 2001; de Araújo & Coulman 2004). There are no reports of *B. riparius* being adventive in Canada.

Bromus riparius was treated in the Flora of North America (Pavlick & Anderton 2007). It was included there shortly before the volume went to press, but a detailed distribution map for the taxon was not available. In Canada, *Bromus riparius* is recognized as part of the flora in Saskatchewan (determined incorrectly as *B. biebersteinii* Roem. & Schult.; Harms 2006). Almost certainly it is present in Alberta, and a recent collection from Manitoba is cited below. It has not yet been reported for British Columbia. There is no mention of *B. riparius* (or *B. biebersteinii*) in recent treatments of the British Columbia flora (Qian & Klinka 1998; Douglas et al. 2001), nor in Pavlick's (1995) treatment of *Bromus* in North America. In May 2006 I collected *B. riparius* in southeastern British Columbia in a fenced-in meadow at a rest stop along Hwy 3 [*Saarela 417* (CAN, UBC)]; this collection apparently represents the first record of the species in the province. Indeed, the species has been grown in field trials in British Columbia (e.g., at Devick near Kamloops; May et al. 1999), and cultivars of *B. riparius* are promoted for forage in British Columbia and used for amelioration (S. J. Darbyshire, pers. comm., March 2007; see http://www.agf.gov.bc.ca/forage/factsheets.htm). *Bromus riparius* may have been deliberately planted here as forage, or it may have been introduced by road traffic. Seed of *B. riparius* is sometimes found as a contaminant in smooth brome seed commodities (Allison et al. 2001; S.J. Darbyshire, pers. comm. March 2007). Whatever the source of the introduction, *Bromus riparius* should be recognized as a component of the British Columbia flora, and additional occurrences for this species should be looked for.

The morphological description is based on my field collections from British Columbia and Manitoba, as well as several specimens of cultivated plants (mostly greenhouse grown at the Agriculture and Agri-Food Canada Central Experimental Farm in Ottawa, Ontario, Canada) in DAO. Some of this cultivated material represents the cultivars 'Fleet,' 'Paddock' and 'Regar'; differentiating morphologically among these and the other cultivars was beyond the scope of this study. *Bromus riparius* is one of three *Bromus* species in British Columbia (including *B. inermis* and *B. pumpellianus*) with rhizomes and long anthers (usually > 4 mm), and it therefore is relatively straight forward to identify. These three species are members of an Old World alliance of taxa (*B. pumpellianus* is the only native species in North America that is part of this group) whose evolutionary relationships with other North American perennial *Bromus* species are not yet clear (Saarela et al. 2007). Because *B. riparius* is a relatively recent addition to the New World flora, there is little information in the North American botanical taxonomic literature for the species.

There are several morphological characters that distinguish *Bromus riparius*. In an effort to identify characteristics to help seed analysts distinguish florets of *B. inermis* and *B. riparius*, which are sometimes mixed in seed commodities, Allison et al. (2001) conducted a careful study of the floret morphology of these taxa and found useful variation in the cilia (described by them as 'siliceous prickle hairs') on the palea keels. In *B. riparius*, cilia on the palea keels are present only distally, whereas in *B. inermis* cilia are present on the keels along the entire palea length. Figures 1–4 and 9 in Allison et al. (2001) illustrate this character clearly. Allison et al. (2001) did not examine this character for *B. pumpellianus*. In *B. pumpellianus* cilia are present along the entire length of the palea keels, like in *B. inermis*, or only along the lower ¾. *Bromus riparius* is further distinguished by its longer awns, which are (3–)4–7.1 mm long [vs. 0–3 mm long in *B. inermis* and 1–4 mm long in *B. pumpellianus*]. Several vegetative characters are also useful in distinguishing the three species. Leaf blade margins of *B. riparius* are characterized by the presence of long, stiff hairs (to 2.5 mm long) that are conspicuously wider at their base (Fig. 14); such robust hairs do not occur in *B. inermis* and *B. pumpellianus*. In his keys to *Bromus* in the (former) U.S.S.R., Tzvelev (1976) distinguished *B. riparius* from *B. inermis* and *B. pumpellianus* by the degree of shredding of basal leaf sheaths. Examination of this character in Canadian material confirms that it is very useful for distinguishing *B. riparius* from the other two taxa. The basal sheaths of decaying leaves in *B. riparius* are reticulate-fibrillose (i.e., they have a 'thatched' appearance), the readily decaying basal sheaths in *B. pumpellianus* are split into straight fibers and the basal sheaths of *B. inermis*, which do not appear to decay as readily as those in *B. pumpellianus* or *B. riparius*, also split into straight fibers (Fig. 15). Pavlick & Anderton (2007) distinguished *B. riparius* from *B. inermis* and *B. pumpellianus* based on culm height and rhizome length; they noted that time constraints did not allow them to fully clarify its similarities and differences with these other taxa. *Bromus riparius* is weakly rhizomatous, *B. pumpellianus* is moderately so and *B. inermis* is strongly rhizomatous. Pavlick & Anderton (2007) also noted that it is not clear how *B. riparius* differs from *B. pumpellianus* subsp. *dicksonii* W. W. Mitch. & Wilton, a taxon known only from the Yukon River drainage in northwestern North America (Yukon and Alaska); characterization of differences between these two taxa was beyond the scope of this study.

Representative Specimens Examined. **CANADA. British Columbia:** Rampart Rest Area, 10 km E of Cranbrook, meadow under *Pinus ponderosa* and *Juniperus scopulorum*, 49°33"2'N 115°8"38' W, 856 m, 23 May 2006, *J.M. Saarela 417* (CAN, UBC). **Alberta:** Lethbridge, 10.15.1987, *S. Smoliak s.n.* (DAO-540342); cultivated land, fallow, NE-19-42-10-W4, 10 mi S of Hardisty, 3 Jun 1993, *T. Yorchak V93W-FC268* (DAO-67859). **Manitoba:** Mary Jane Reservoir, ca. 10 km NW of Manitou, open, relatively undisturbed prairie habitat S of the reservoir, 14 Jul 2007, *J.M. Saarela 1001* (CAN). **Ontario (cultivated):** Ottawa, Central Experimental Farm, greenhouse, cv. Fleet, 7 Aug 1992, *S.J. Darbyshire s.n.* plant #28 (DAO-668498), plant #17 (DAO-668495), plant #25 (DAO-668496), plant #8 (DAO-668494), plant #9 (DAO-668493), plant #27 (DAO-668497), plant #31 (DAO-668500), plant #29 (DAO-668499); Ottawa, Central Experimental Farm, greenhouse, cv. Fleet, planted 26 Nov 1996, received as breeder seed C-86-2778, accession number 183, 22 Nov 1997, *M. Murray s.n.* (DAO-747661); Ottawa, Central Experimental Farm, collected from greenhouse, cv. Fleet, source: seed and rootstalks sent by R.P. Knowles in late 1987 from Saskatoon, 15 Apr 1988, *S.J. Darbyshire s.n.* (DAO-575082); grown at Saskatchewan, Saskatoon, cv. Fleet, received in Ottawa as live plant 17 Sep 1987, *R.P. Knowles # Fleet PH 12-5* (DAO-547672); grown at Saskatchewan, Saskatoon, cv. Fleet, received in Ottawa as live plant, 17 Sep 1987, *R.P. Knowles # Fleet PH 12-32* (DAO-547670); Ottawa, Central Experimental Farm, greenhouse, cv. Paddock, 7 Aug 1992, *S.J. Darbyshire s.n.* plant # 19 (DAO-668488), plant #31 (DAO-668492), plant #30 (DAO-668490), plant #10 (DAO-668487), plant #17 (DAO-668486), plant #27 (DAO-668489), plant #32 (DAO-668491); Ottawa, Central Experimental Farm, greenhouse grown, cv. Paddock, 23 Oc 1991, *S.J. Darbyshire 4337* (DAO); Ottawa, Central Experimental Farm, greenhouse, cv. Regar, planted 26 Nov 1996, received as breeder seed C-94-2023, 10 Nov 1997, *M. Murray s.n.* (DAO-74330); Ottawa, Central Experimental

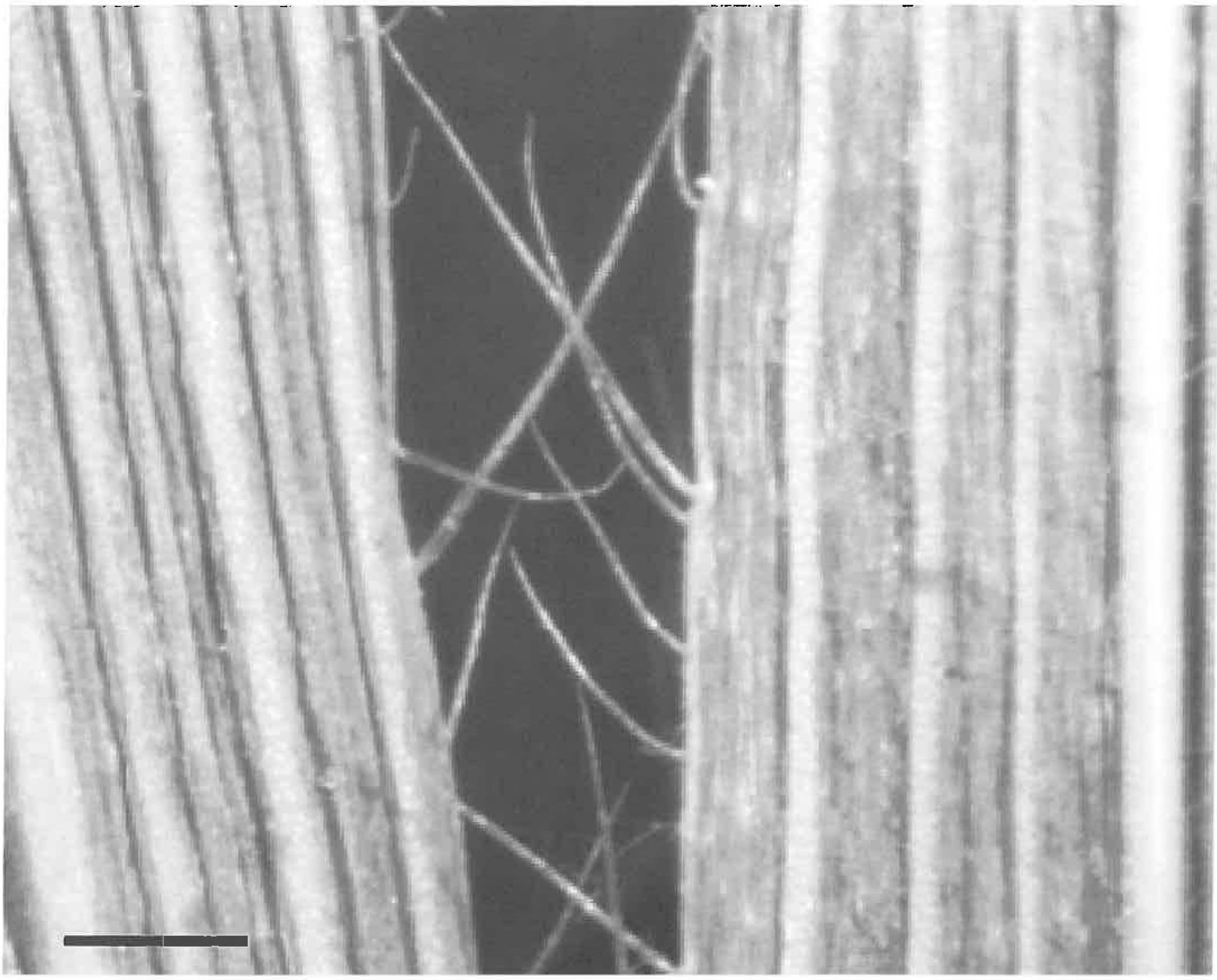

Fig. 14. Leaf blades of *Bromus riparius* [*Saarela 417* (CAN)], showing the long, robust marginal hairs that characterize the species. Scale bar = 1.5 mm.

Farm, greenhouse, cv. Paddock, planted 26 November 1996, received as breeder seed C-86-2787, accession number 182, 26 Oct 1998, *M. Murray s.n.* (DAO-747653); Ottawa, Central Experimental Farm, cold frames, 23 Jun 1989, *S.J. Darbyshire s.n.* (DAO-594764, DAO-593967). **UNITED STATES OF AMERICA. WASHINGTON:** Cultivated at ARS-Pullman [from seeds (PI Identifier 31587) collected at: Russian Federation, Stavropol, Stavropol Territory, 16 Jun 1966, *N. I. Vavilov, All-Russian Scientific Research 2*], 14 Aug 1996, *S.M. Saufferer s.n.* (DAO-594935).

14. Bromus secalinus L., Sp. Pl. 1:76. 1753. (**Figs. 16A–E, 13B**). *Bromus mollis* var. *secalinus* (L.) Huds., Fl. Angl., ed. 2. 2:49. 1778. *Avena secalina* (L.) Salisb., Prodr. Stirp. Chap. Allerton 22. 1796. *Serrafulcus secalinus* (L.) Bab., Man. Brit. Bot. 1:374. 1843. *Forasaccus secalinus* (L.) Bubani, Fl. Pyren. 4:388. 1901. Type: EUROPE: habitat in Europae agris secalinis arenosis, *Anon.* (neotype: LINN-93.1, designated by P.M. Smith, Notes Roy. Bot. Gard. Edinburgh 42:498. 1985).

Bromus submuticus Steud., Syn. Pl. Glumac. 1:351. 1854. Type: U.S.A. Missouri: St. Louis, 1838, *N. Riehl s.n.* (isotype: US-865472, fragment).

Annual; rhizomes absent. Culms 23–130 cm tall, 1–5(–7) mm wide at base, smooth; nodes 3–5, blackish-brown to yellow-brown, finely to densely retrorsely pubescent, hairs 0.1–0.4 mm long, lower nodes covered by sheaths. Leaf sheaths glabrous or sparsely pilose, hairs soft, 0.5–0.6 mm long; auricles absent; ligules 1.7–2.8 mm long, membranous, glabrous, apex erose; blades 8–28.5 cm long, 2–9 mm wide, abaxial surface pilose, hairs to 1.5(–2) mm long, soft and wavy, adaxial surface glabrous with occasional hairs to 0.5 mm long, margins smooth. Panicles 11–22 cm long, 2–9 cm wide, open, branches stiffly erect, sometimes secund, one or more lower branches usually longer than spikelet, smooth to scabrous, 1–3 spikelets per branch, lowest inflorescence node with 1–6 branches; 6–36 spikelets. Spikelets 1.3–2.5 cm long, ovate-lanceolate, terete to slightly compressed, rachilla zigzagged and visible at maturity, florets 5–12. Glumes slightly subequal, smooth or scabrous, keels occasionally serrulate distally; lower glumes 3.6–4.9 mm long, 3–5(–7)-nerved; upper glumes 4.2–6.1 mm long, 7-nerved, sometimes mucronate, mucros 0.2–0.6 mm long. Lemmas 6–7.7 mm long, 1.6–3 mm wide, 7–9-nerved, nerves not conspicuous, ovate-lanceolate, backs glabrous and shiny, occasionally scabrous distally, margins dinstinctly inrolled in fruit; apex entire or minutely bifid, the cleft 0.1–0.2 mm deep; awns 1–6.5 mm long, occasionally reduced to mucro or absent, arising 0.5–0.7 mm below lemma apex, usually straight, occasionally twisted once near base, widest at base, antrorsely scabrous. Paleas ± equal in length to lemmas, apex usually visible at lemma summit, backs glabrous, keels ciliate, cilia to 0.3 mm long. Stamens 2; anthers 1–1.3 mm long, dark brown. Caryopses U- or V-shaped (i.e., margins strongly infolded) in cross section. $2n = 28$.

Distribution and Habitat.—Introduced. In North America, *B. secalinus* has been collected throughout the U.S.A. and southern Canada. It is apparently absent from the Canadian prairie provinces. In the U.S.A. it is most common in the midwestern states (Pavlick & Anderton 2007). *Bromus secalinus* has been collected only a few times in British Columbia, mostly in the southwestern part of the province (Fig. 13B); the most recent collection is from 1991. Habitat includes waste places and fields.

Common Names.—English: cheat, cheat chess, cheat grass, chess, chess brome, ryebrome, rye brome; French: brome des seigles, brome sécaline, coquiole noire, séglin, seigle bâtard, brome faux seigle, seiglin.

Representative Specimens Examined. **CANADA. British Columbia:** Hazelton, [date illegible], *G. Gervais s.n.* (UBC); Alberni, 1900, [collector illegible] (V); Vancouver Island, district of Renfrew, 19 Jul 1902, *C.O. Rosendahl 787* (CAN); Beacon Hill, 22 Jul 1913, *J. Macoun s.n.* (V); within 5 mi of Lillooet, 7 Jul 1916, *J.M. Macoun 93,964* (CAN, V); Swan Lake, Vancouver Island, 13 Jul 1938, *J.W. Eastham s.n.* (UBC); New Westminster, 12 Jul 1991, *F. Lomer 91-149* (UBC).

KEY TO THE VARIETIES OF *BROMUS SQUARROSUS*

15a. Glumes and lemmas glabrous or scabrous __________ **B. squarrosus** var. **squarrosus**

15b. Glumes and lemmas densely pubescent, hairs to 0.8 mm long ______ **B. squarrosus** var. **villosus**

15a. Bromus squarrosus L. var. **squarrosus**, Sp. Pl. 1:76. 1753. **(Figs. 13C, 16F–I)**. *Serrafalcus squarrosus* (L.) Bab., Man. Brit. Bot. 375. 1843. *Forasaccus squarrosus* (L.) Bubani, Fl. Pyren. 4:385. 1901. *Bromus japonicus* var. *paniculatus* (Kuntze) Roshev., Fl. Turkmen. 1:171. 1932. Type: SPAIN: *Loefling 79a* (Lectotype: LINN-93.8, designated by Smith, Notes Roy. Bot. Gard. Edinb. 42:500. 1985).

Annual; rhizomes absent; plants 10–43 cm tall. Culms 1–2 mm wide at base, smooth; nodes 2–3, dark brown, pubescent, hairs to 0.6 mm long. Leaf sheaths closed for most of their length, open for 4.2–9 mm

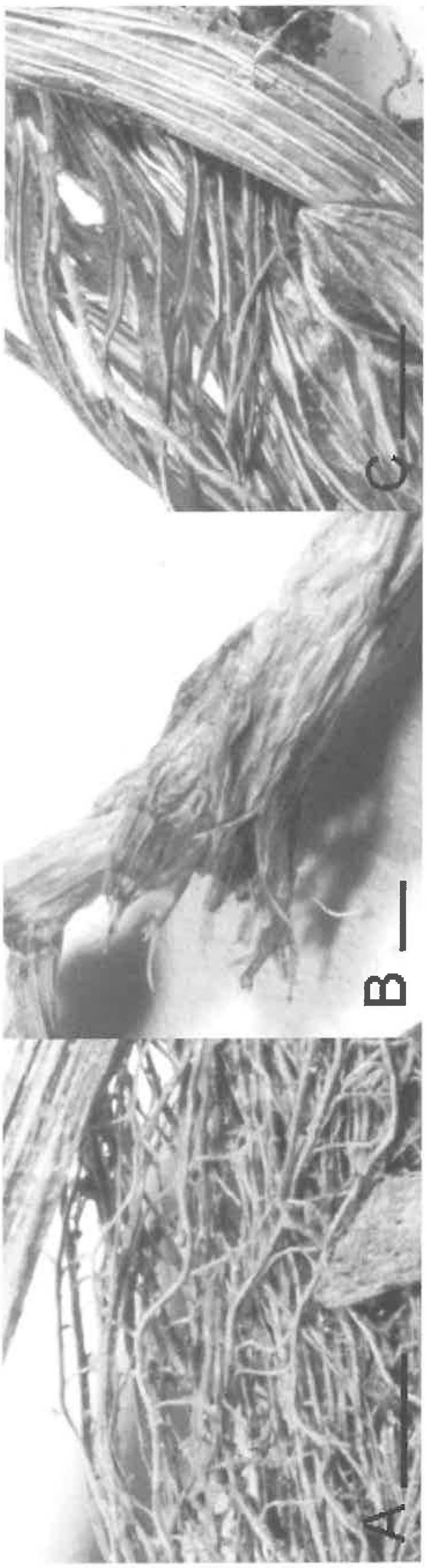

Fig. 15. Pattern of decay in basal leaf sheaths. A. *Bromus riparius* [*Saarela 417* (CAN, UBC)]. Basal sheaths decay readily and are reticulate-fibrillose. B. *Bromus inermis* [*Brink s.n.* (UBC-V215195)]. Basal leaf sheaths do not decay readily; when they do decay, they split into straight fibers. C. *Bromus pumpellianus* [*n.c.* (UBC-V221751)]. Basal leaf sheaths readily decay into straight fibers. Scale bars = 1.5 mm.

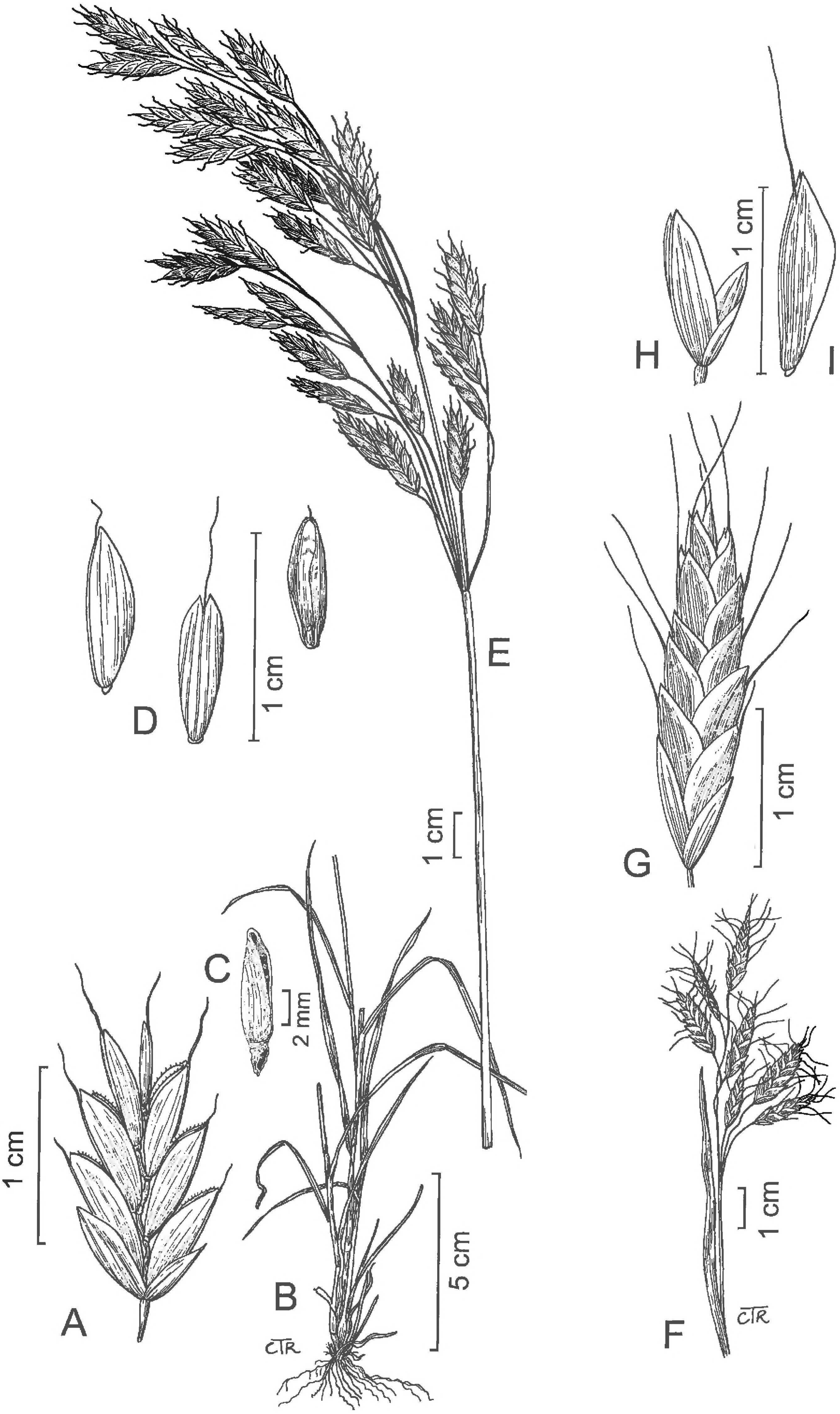

Fig. 16. ***Bromus secalinus*****. A.** Spikelet. **B.** Habit. **C.** Caryopsis. **D.** Lemmas. **E.** Inflorescence. ***Bromus squarrosus*****. F.** Inflorescence. **G.** Spikelet. **H.** Glumes. **I.** Lemma.

near apex, densely pilose with soft or sometimes stiff hairs 0.5–2 mm long; auricles absent; ligules 0.5–2 mm long, membranous, pubescent, apex erose; blades 2.5–10 cm long, 1.5–3 mm wide, abaxial surface densely pubescent, hairs 0.5–1.5 mm long, adaxial surface glabrous or minutely to densely pubescent, hairs stiff and short or like abaxial surface than, margins smooth or serrulate. Panicles (5–)7–10.5 cm long, 2.7–7 mm wide, open, lax and somewhat sparse, racemose, often appearing one-sided (secund), sometimes reduced to a single spikelet, one or more lower branches usually longer than spikelet, branches smooth to scabrous, 1(–2) spikelets per branch, lowest inflorescence node with 1–4(–5) branches; 3–17 spikelets. Spikelets 1.4–3.5 cm long, broadly oblong to ovate-lanceolate, terete to moderately compressed, rachillas not visible at maturity, florets 7–18. Glumes subequal, smooth, margins sometimes hyaline; lower glumes 4.5–7 mm long, 3–5(–7)-nerved; upper glumes 6.1–9.5 mm long, 7-nerved. Lemmas 8.2–11 mm long, 1.8–3.1 mm wide (when compressed), 7–9-nerved, nerves not conspicuous, broadly obovate, strongly angled near the middle, backs glabrous or scabridulous or (rarely) densely pubescent with hairs to 0.5 mm long, hyaline margins 0.5–1.2 mm wide at widest point, puberulent, apex minutely bifid, the cleft 0.1–0.3 mm deep; awns 8–11.7 mm long (awn on lowest lemma shorter), arising 1.7–3 mm below lemma apex, strongly divergent, usually twisted once near base, widest at base, scabrous. Paleas 6.1–9 mm long, backs glabrous, keels ciliate, cilia 0.3–0.5 mm long. Stamens 2; anthers (0.5–)0.9–1.6 mm long, dark brown. $2n = 14$.

Distribution and Habitat.—Introduced. *Bromus squarrosus* var. *squarrosus* is native to Eurasia (Tzvelev 1976). In North America it occurs across the Great Plains in the northern U.S.A., around the Great Lakes area and in other scattered locations (Pavlick & Anderton 2007). In British Columbia it is most common in the interior and in the Columbia basin (Fig. 13C). Habitats include grasslands, hillsides, disturbed areas and roadsides. Elevation: 311–823 m.

Common Names.—corn brome, downy brome, field brome, nodding brome, one-way brome.

Representative Specimens Examined. **CANADA. British Columbia:** near Kamloops, 2000 ft, 27 May 1934, *G. V. Copley 7* (DAO); Richter Pass, Jul 1936, *E.W. Tisdale 8850* (UBC); Kamloops, 22 Jun 1939, *E.W. Tisdale 8759* (UBC); Lac du Bois, Kamloops, 4 Aug 1939, *E.W. Tisdale 8760* (UBC); Kamloops, Sep 1939, *E.W. Tisdale 8761* (UBC); Lac du Bois, Kamloops, 2700 ft, 10 Aug 1939, *E.W. Tisdale 40-8* (DAO); Ashcroft, 6 Aug 1950, *V.J. Krajina s.n.* (UBC); Tranquille, 1100 ft, 5 Oct 1962, *V.C. Brink s.n.* (UBC); Bonaparte River Valley, 15 mi N of Cache Creek, 1200 ft, 20 Jun 1965, *V.J. Krajina 65062007* (UBC); St. Eugene Mission, Cranbrook, 23 Jun 1968, *F. Fodor 647* (UBC); Kamloops, Lac du Bois Range behind Research Station, 23 Jun 1980, *S.G. Aiken 1071* (DAO); Dallas Cliff (Point), 17 Jun 1982, *R.K. Scagel 82-28* (UBC); N of Copper Creek, towards Tranquille Lake, 9 Jul 1991, *F. Lomer 91-139* (UBC); Kootenay, Wasa, 20 Jun 1993, *L.E. Pavlick 93-044* (V); Cariboo-Chilcotin, Dog Creek area, Harper's Creek Valley (S of creek), 3 Jul 1994, *T. Goward & C. Clement 94-377* (UBC); Anarchist Mt, E of Osoyoos near Hwy 3, 15 Jul 1994, *F. Lomer 94-152* (UBC); near border of N end of Yale region and S end of Kamloops region, a few km S of Kanaka Bar by pullout on Hwy 1, 17 Aug 1995, *F. Lomer 95-166* (UBC); 8 km E of Kamloops, 26 May 1998, *P. Williston PW98-134* (UBC); W of Osoyoos, 1.3 km up Richter Mountain Road, 19 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 628* (CAN, UBC).

15b. **Bromus squarrosus** L. var. **villosus** Roth, Neue Beytr. Bot. 1:109. 1802. (**Figs. 13C, 17**).

Similar to var. *squarrosus*, but glumes and lemmas densely pubescent with hairs to 0.8 mm long.

Distribution and Habitat — In North America *B. squarrosus* var. *villosus* is only known from the three southern British Columbia collections cited below. Additional occurrences in North America should be searched for in the field and in herbaria. Tzvelev (1976:335) indicated that, in its native range, the variety is somewhat rarer in distribution than the typical variety.

Notes.—Nomenclature used here follows Kerguélen (1999). *Bromus squarrosus* var. *villosus* Roth is reported here for the first time for continental North America. Material examined from British Columbia closely matches material seen from Russia [e.g., *Skvortsov s.n.* (CAN-578016!) collected in Volgograd]. The description for *B. squarrosus* by Pavlick (1995) and Pavlick & Anderton (2007) does not mention the presence of dense pubescence in the taxon, which suggests that these authors did not observe pubescent forms of the species. The 1993 record from British Columbia was collected by Pavlick, but this was likely long after he completed work on his revision of *Bromus* for North America (Pavlick 1995).

Specimens Examined. **CANADA. British Columbia:** Kootenay, Grand Forks, Gilpin Forest Service Road, E of Grand Forks, 23 Jun 1993, *L.E. Pavlick 93-143* (V); roadside pullout on W side of Hwy 1 (Trans Canada) at Hells Gate, 22 Jun 2006, *J.M. Saarela, C. Sears &*

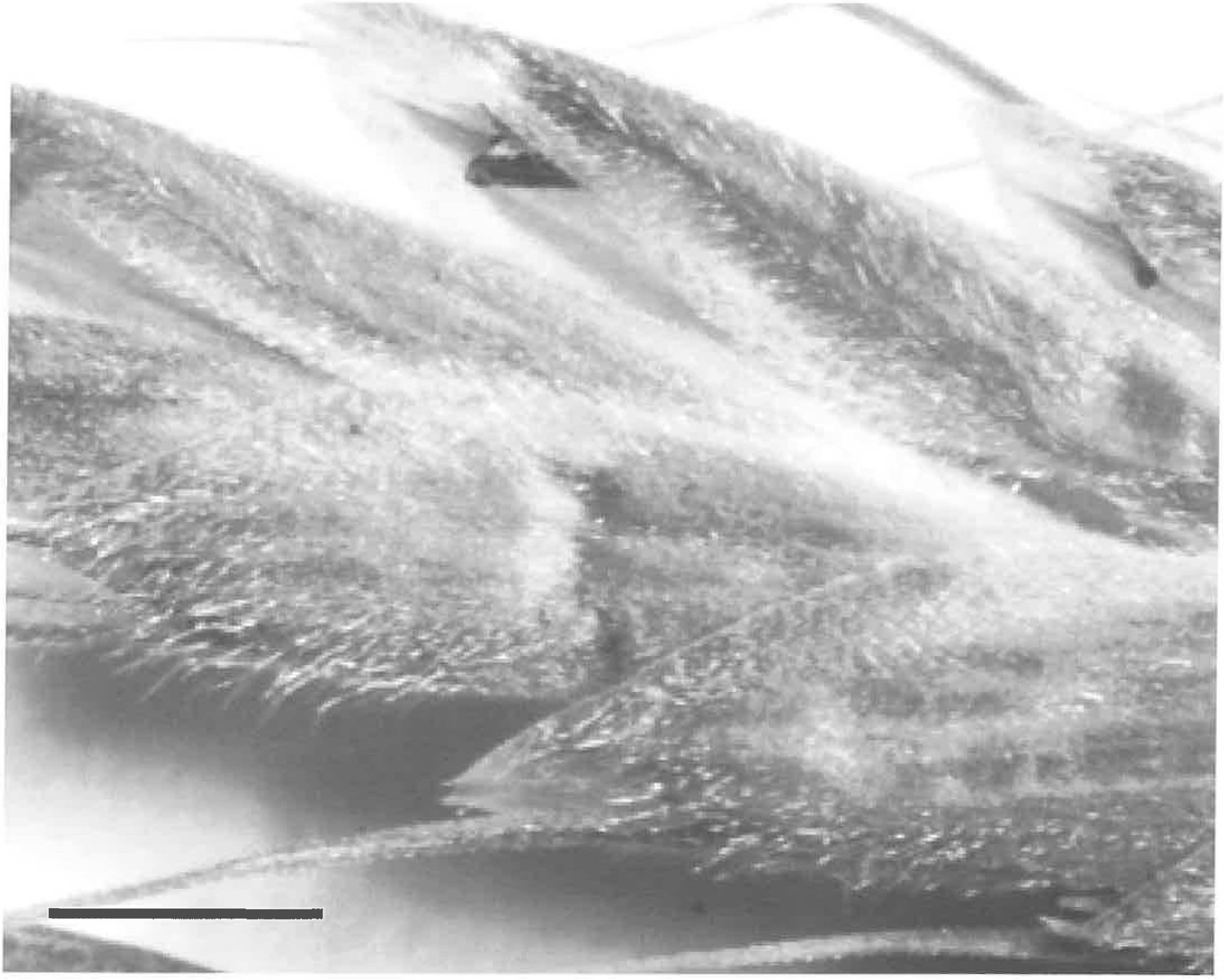

Fig. 17. Lemma morphology of *Bromus squarrosus* var. *villosus* [*Saarela, Sears & Maze 736* (CAN)], differing from the typical variety by the presence of dense pubescence to 0.8 mm long. Scale bar = 2.5 mm.

J. Maze 736 (CAN, UBC); Waneta, confluence of Columbia and Pend d'Oreille rivers, along railroad tracks opposite fishing pullover on Hwy 22A, 1400 ft, 17 Jun 2007, *F.L. Lomer 6268* (CAN, UBC, V).

16. Bromus sterilis L., Sp. Pl. 1:77. 1753. (**Figs. 18A–E, 19A**). *Schedonorus sterilis* (L.) Fr., Bot. Not. 131. 1843. *Genea sterilis* (L.) Dumort., Bull. Soc. Roy. Bot. Belgique 7:67. 1868. *Anisantha sterilis* (L.) Nevski, Trudy Sredne-Aziatsk. Gosud. Univ., Ser. 8b, Bot. 17:20. 1934. Type: ENGLAND. Surrey: Tothill, near Headley, scattered plants in derelict hay-field on heavy soil overlying chalk, 15 Jun 1932, *C. E. Hubbard 9045* (conserved type: E, proposed by Sales, Taxon 41:584. 1992; isoneotype: K).

Annual; rhizomes absent. Culms 25–110 cm tall, 2–4 mm wide at base, smooth; nodes 3–5, light to dark brown, glabrous, lower nodes usually covered by sheaths. Leaf sheaths closed for most of their length, open for 8–15 mm in length, moderately to densely pubescent with short stiff hairs to 0.5 mm; auricles absent; ligules 2.3–4.6 mm long, membranous, glabrous or pubescent, erose-lacerate; blades 4.5–22 cm long, 2–6 mm wide, adaxial surface glabrous, minutely pubescent or densely pilose with soft, wavy hairs to 2.5 mm long, long hairs sometimes only along the margins, abaxial surface minutely pubescent with small appressed hairs, margins smooth. Panicles 10–28 cm long, 3–18.5 cm wide, dense and ascending when young, becoming open and lax; branches usually longer than spikelets, shorter when panicle reduced to 1(2, 3) spikelets, 1(–3) spikelets per branch, lowest inflorescence node with 4–6 branches. Spikelets 4.5–6.7 cm long (including awns), cuneate, subcylindric-compressed, rachilla sometimes visible at maturity, florets 3–11.

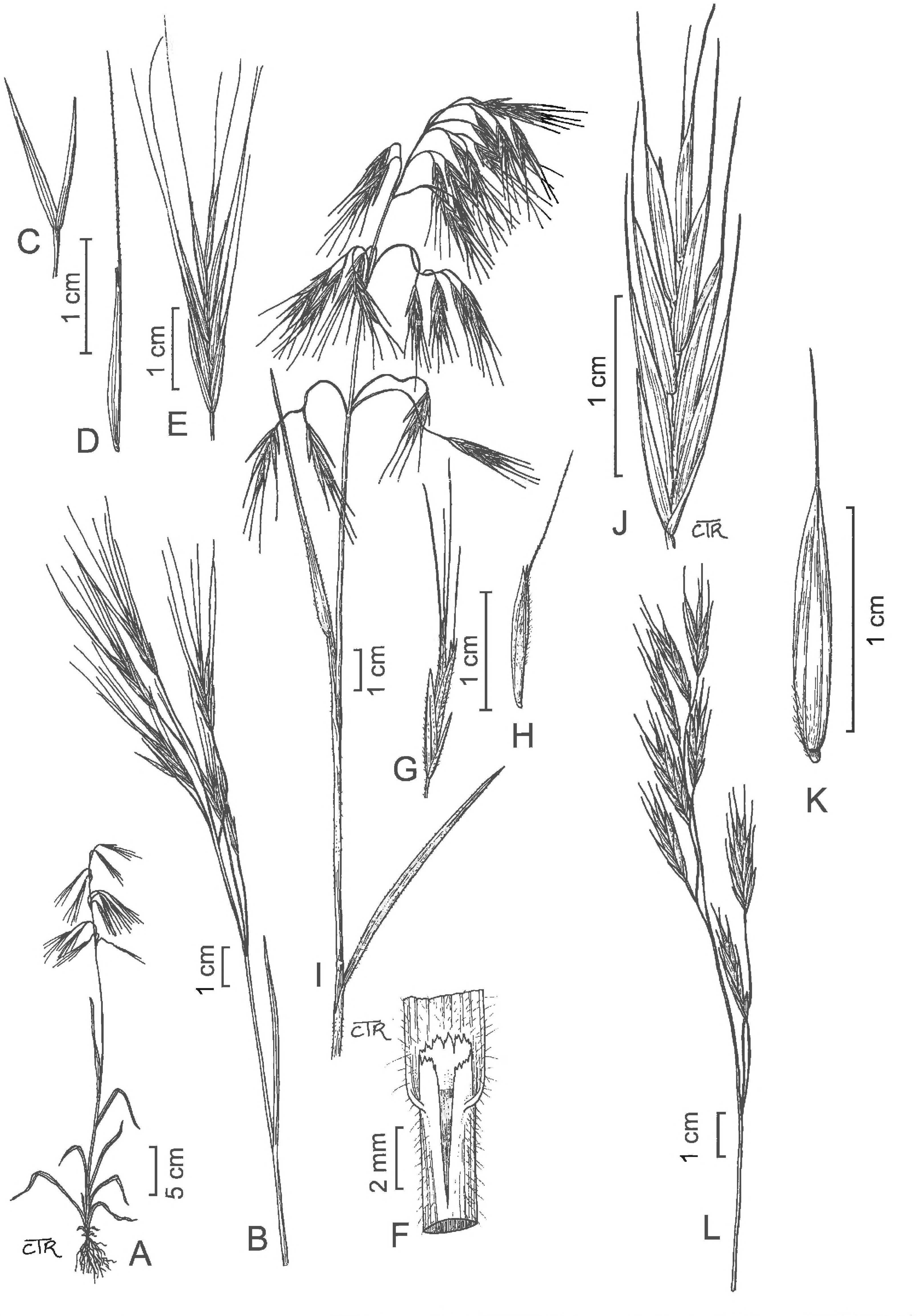

FIG. 18. *Bromus sterilis*. A. Habit. B. Inflorescence. C. Glumes. D. Lemma. E. Spikelet. *Bromus tectorum*. F. Ligule. G. Spikelet. H. Lemma. I. Inflorescence. *Bromus vulgaris*. J. Spikelet. K. Lemma. L. Inflorescence.

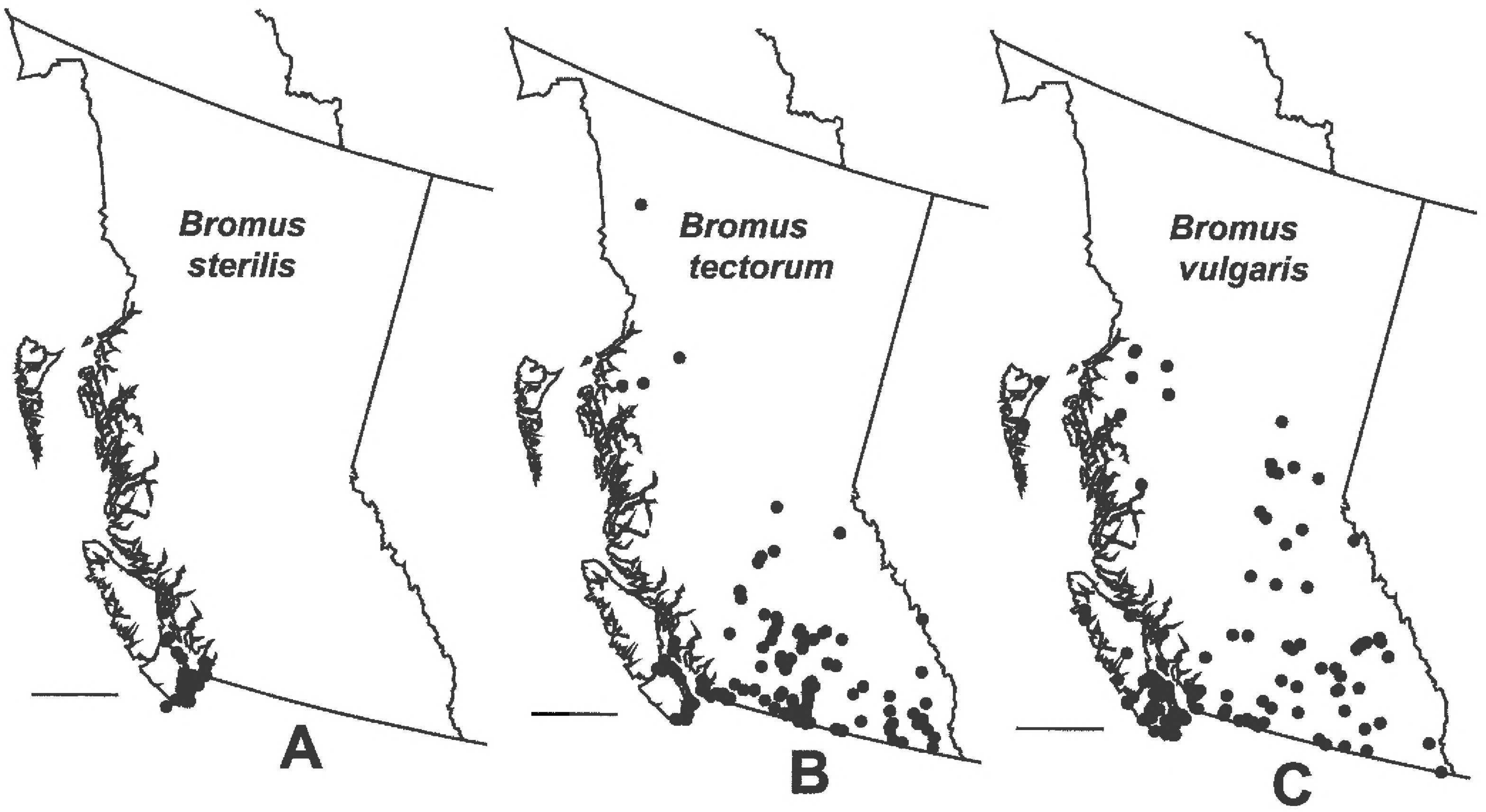

Fig. 19. Geographic distribution in British Columbia. A. *Bromus sterilis*. B. *Bromus tectorum*. C. *Bromus vulgaris*. Scale bars = 200 km.

Glumes subequal, lanceolate, smooth, keels smooth or scabrous, margins hyaline; lower glumes 10–14 mm long, 1–3-nerved; upper glumes 7.5–21 mm long, 3–5-nerved. Lemmas 13–22 mm long, 1.1–1.7 mm wide, 7-nerved, nerves conspicuous, lanceolate, backs smooth or scabridulous, scabrules sometimes increasing in density distally, margins not distinctly inrolled in fruit, apex bifid, the cleft 1–3 mm deep; awns 15–30 mm long, arising about 1.5 mm below lemma apex, straight, antrorsely scabrous. Paleas 9.5–13.5 mm long, much shorter than lemma, backs glabrous, keels glabrous or ciliate, cilia often present only distally, cilia to 0.2 mm long. Stamens 3; anthers 1.3–1.7 mm long, dark brown. $2n$ = 14, 28.

Distribution and Habitat.—Introduced. *Bromus sterilis* is native to Europe, northern Africa and southwestern Asia (Sales 1993). In North America it occurs in western and eastern North America (Pavlick & Anderton 2007). In British Columbia *B. sterilis* occurs only in the extreme southwest of the province in the Vancouver area and on central to southern Vancouver Island (Fig. 19A). Habitats include roadsides, sandy beaches, meadows and waste places. Elevation: 0–425 m.

Common Names.—barren brome, poverty brome.

Notes.—Several intraspecific taxa that have been previously recognized are mentioned by Sales (1993:5-6), but she did not recognize these; none have been recognized in the North American flora.

Representative Specimens Examined. **CANADA. British Columbia:** vicinity of Victoria, 20 Jun 1908, *Macoun 76,833* (CAN); Victoria, Anderson's farm, 27 May 1893, *Macoun 117* (CAN); Victoria, 13 Jun 1908, *Macoun 76,835* (CAN); Vancouver Island, Saanichton, 15 May 1913, *Macoun 88,540* (CAN); Oak Bay, Victoria, 17 Jun 1913, *Macoun 88,541* (CAN, V); Victoria, 6 Jun 1908, *Macoun 76,834* (CAN); Victoria, 11 May 1920, *G.W. Copley 1-14* (DAO, UBC); Sidney, 30 Sep 1930, *H. Groh s.n.* (DAO); Shawnigan Lake, 27 May 1931, *H. Groh s.n.* (DAO); Crescent Beach, 31 May 1937, *J.W. Eastham s.n.* (CAN); Victoria, 2 Jun 1938, *J.W. Eastham 431* (DAO, UBC); W Point Grey, Jun 1939, *J.W. Eastham s.n.* (DAO); W Point Gray, Vancouver, Jun 1939, *J.W. Eastham 429* (UBC); Saanichton, 21 Jun 1939, *W.R. Foster s.n.* (DAO, UBC, V); James Island, off Saanichton, 5 Aug 1939, *H. Groh 424* (DAO); No. 5 road, Lulu Island, 0.25 mi S of Twigg Island, 4 Jun 1944, *J.W. Eastham 11426* (DAO, UBC); Whiffen Spit, Sooke, 19 May 1948, *V.C. Brink 48-28* (UBC); Victoria, Finlayson Point, 20 May 1950, 10 m, *V. Krajina & R.H. Spilsbury 3921* (DAO); Esquimalt Lagoon near Victoria, 7 May 1962, *J. Hett 90* (DAO); Happy Valley near Victoria, 30 May 1962, *J. Hett s.n.* (DAO); Henderson Point, Brentwood, 16 Jun 1967, *A. S. Harrison 20.1* (CAN); Victoria, Finlayson Point, 10 m, 20 May 1950, *V. Krajina & R.H. Spilsbury 3921* (UBC); 2 mi E of Duncan, 19 May 1955, *D.R. Lindsay & W. Woodbury 737* (DAO); John Dean Park, Saanichton, 14 Jun 1962, *J. Hett 16* (DAO); Little Saanich Mtn, 350 ft, 17 May 1965, *B.W. Davies 389* (DAO); Mt Finlayson, 425 m, 28 Jun 1978, *L. Pavlick 78-231* (V); Mt Finlayson, 300 m, 16 May 1979, 300 m, *L.E. Pavlick 79-6* (V); Saltspring Island, Mt Tuam, 3 Jul 1982, *L.E. Pavlick 82-19* (V); Vancouver Island, Mt Finlayson, E of Goldstream Provincial Park, 1 Jul 1982, *S.G. Aiken, S.J. Darbyshire & L.E. Pavlick 2118* (DAO); Mount Douglas Park, Saanich Peninsula, 4 Jul 1988, *S.J. Darbyshire 3792* (CAN, DAO); S end of Tsawassen Drive S, Tsawassen Indian Reserve #0, 28 May 2006, *J.M. Saarela & C. Sears 546* (CAN, UBC); Mayne Island, Bennett Bay, Gulf Islands National Park Reserve of Canada, Wilkes Road off Bennett Bay Road, 3 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 826* (CAN, UBC); Mayne Island, cliff edge of Mount Park, ca. 1 km W of highest point where radar tower is, 3 Jun 2007, *J.M. Saarela, D.M. Percy, Y. Chang & Q. C. E. Cronk 808* (CAN, UBC); Vancouver Island, Thetis Lake Regional Park, just N of Hwy 1, N of Langford, 4 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 861* (CAN, UBC); Vancouver Island, just S of Chemanus along Hwy 1A, 6 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 909* (CAN, UBC); Vancouver Island, just off Hwy 19A along Crane Road, N of Qualicum Beach, at confluence of Nile Creek and the Straight of Georgia, 7 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 934b* (CAN, UBC).

17. Bromus tectorum L., Sp. Pl. 77. 1753. (**Figs. 18F–I, 19B**). *Zerna tectorum* (L.) Panz., Denkschr. Konigl. Akad. Wiss. Munchen 1813:297. 1814. *Schedonorus tectorum* (L.) Fries, Bot. Not. 131. 1843. *Anisantha tectorum* (L.) Nevski, Act. Univ. Asiae Med. 8b., Bot. 17:20, 22. 1934. *Genea tectorum* (L.) Dumort., Bull. Soc. Bot. Belg. 7:67. 1868., in adnot. Type: EUROPE: *Anon.* (lectotype: LINN 93/25, designated by Smith, Notes. Roy. Bot. Gard. Edinb. 42:500. 1985).

Bromus tectorum var. *nudus* Klett & Richt., Fl. Leipzig 109. 1830. *Bromus tectorum* L. subsp. *nudus* (Klett & Richt.) Piper & Beattie, Fl. N. W. Coast 51. 1915. *Bromus tectorum* f. *nudus* (Klett & Richt.) St. John, Fl. S. E. Washington (Piper & Beattie) 36. 1937. *Bromus tectorum* f. *glabratus* (Spenn.) St. John, Fl. S.E. Washington (Piper & Beattie), ed. 2. 536. 1956. Type: not known.

Bromus setaceus Buckl., Acad. Nat. Sci. Phila. Proc. 1892:98. 1862. Type: U.S.A. Texas: *Buckley s.n.* (lectotype: US-865474!, designated by Hitchcock, Man. Grass. U. S. 817. 1935).

Annual; rhizomes absent; 5–80 cm tall. Culms 0.7–2.5 mm wide at base, smooth; nodes 2–4, blackish brown, glabrous or minutely pubescent. Leaf sheaths closed for most of their length, glabrous or variously pubescent with dense, stiff hairs to 0.5 mm or long, soft, wavy hairs to 1 mm long, longer hairs to 2 mm long sometimes present towards sheath apex; auricles absent; ligules (1–)2–3 mm long, membranous, glabrous, erose-lacerate; blades 1.3–14 cm long, 1–5 mm wide, adaxial surface pubescent with sparse to dense short, stiff hairs to 0.3 mm long, abaxial surface puberulent with minute, appressed hairs ca. 0.1 mm long, hairs sometimes denser towards blade apex, margins smooth or with hairs like adaxial leaf surface. Panicles 4–22 cm long, 1–13.5 cm wide, condensed and ascending when young, becoming lax and nodding, sometimes reduced to a few spikelets, branches longer or shorter than spikelets, scabrous to densely pubescent, 1–14 spikelets per branch, lowest inflorescence node with 1–8 branches. Spikelets 2.5–3.5 cm long (including awns), cuneate, sometimes broadening at maturity, rachillaes sometimes visible at maturity; florets 3–6(–8). Glumes subequal, lanceolate, apices ± bifid, the cleft 0.1–0.5 mm deep, glabrous or minutely to densely pubescent with short, appressed hairs, with occasional long, soft hairs to 1 mm long, these sometimes occurring in a line just inside margins, margins hyaline, keels smooth or scabrous; lower glumes 4–9 mm long, 1(–3)-nerved, occasionally minutely awned, awn to 1.1 mm long; upper glumes 7–13.5 mm long, 3(–5)-nerved. Lemmas 9–13.8 mm long, (0.6–)0.9–1.5 mm wide, 7-nerved, backs glabrous, scabrous, or pubescent with long, soft hairs to 1 mm long, sometimes denser along margins and sometimes only pubescent on upper 2/3; keels smooth or serrulate, apex bifid, the cleft 1–3 mm deep; awns 8–18 mm long, arising 1.1–2.7 mm below lemma apex, straight, antrorsely scabrous. Paleas 7–8.7 mm long, shorter than lemma, backs glabrous and translucent, keels ciliate, cilia to 0.6 mm long. Stamens 3; anthers 0.5–0.9 mm long, dark brown. $2n = 14$.

Distribution and Habitat.—Introduced. *Bromus tectorum* is widespread across the United States and southern Canada, with scattered collections from locations in Alaska, Yukon and the western Northwest Territories (Pavlick & Anderton 2007; Valliant et al. 2007). The species is most common in the southern half of the province and it has been collected sporadically in northwestern British Columbia [Fig. 19B; see Valliant et al. (2007) for another recent distribution map]. Habitats include roadsides, fields, meadows, arid slopes, woodlands, cliffs and talus slopes, hillsides, dry rangeland, pastures, sandy beaches, railroad tracks and other waste places. Elevation: 0–1800 m.

Common Names.—English: cheatgrass, cheat grass, downy brome, drooping brome, early chess, military grass, thatch bromegrass; French: brome des toits, brome des murs.

Notes. —*Bromus tectorum* is a serious invasive weed. It was first recorded in North America from Pennsylvania in 1790, and the first report in western North America is from Spence's Bridge, British Columbia (Mack 1981; specimen cited below). Numerous genetic studies have indicated that *B. tectorum* in North America is highly inbreeding and has very low levels of genetic variation across its North American range (e.g., Novack et al.

1991; Bartlett et al. 2002; Ramakrishnan et al. 2006). Genetic variation within populations, however, shows strong regional differentiation, with populations in British Columbia having the highest level of within-population variation among those sampled across North America (Bartlett et al. 2002). Multiple introductions of *B. tectorum* into North America have been documented using genetic data (e.g., Mack 1981; Novack et al. 1991; Novack & Mack 1993, 2001; Bartlett et al. 2002). Valliant et al. (2007) provide an account of the introduction history of *B. tectorum* in British Columbia and Canada; based on allozyme data they identified a minimum of five independent introductions of *B. tectorum* into western Canada.

Representative Specimens Examined. **CANADA. British Columbia:** Spence's Bridge, 4 Jun 1889, *Macoun 29,989* (CAN); Mt Arrowsmith, 6 Aug 1900, *Fletcher and Anderson 22132* (DAO); Okanagan, Summerland, Jul 1912, *E. Wilson 1061* (UBC); Sidney, 7 Jul 1913, *M.O. Malte 27* (CAN); Spence's Bridge, 15 Jul 1913, *J. Davidson s.n.* (UBC); Twaal Valley, 21 Jun 1914, *J. Davidson s.n.* (UBC); near Moren's Ranch, Spence's Bridge, 21 Jun 1914, *J. Davidson s.n.* (UBC); Point Grey, 2 May 1915, *J. Davidson s.n.* (UBC); Pemberton Trail, 24 Jun 1916, *J.M. Macoun 93962* (CAN); Lillooet, 2 Jul 1916, *J.M. Macoun 93963* (CAN); Hazelton, Skeena River, 12 Jul 1917, *J.M. Macoun 93975* (CAN); Okanagan Lake, 17 Jun 1918, *A. H. Hutchinson s.n.* (UBC); Courtenay Lake, 21 Jun 1918, *Hutchinson s.n.* (UBC); Powell River, Jun 1923, *J. B. Munro s.n.* (UBC); White Rock, 25 May 1924, *T.R. Ashlee s.n.* (UBC); Eburne, 23 May 1931, *H. Groh s.n.* (DAO); Langley Prairie, 30 May 1931, *H. Groh s.n.* (DAO); Oliver, 3 Jun 1931, *H. Groh s.n.* (DAO); Kamloops, 4-7 Sep 1931, *V. Kujala & A. Cajander s.n.* (CAN); E of Lytton, 500 ft, 11 Jul 1932, *E.P. Hume s.n.* (UBC); near Kamloops, 2000 ft, 27 May 1934, *G. V. Copley 8* (DAO); near Cranbrook, 13 Aug 1934, *E.H. Moss 2942* (DAO); Spence's Bridge, Kamloops district, 24 May 1935, *D.W. Thompson s.n.* (DAO); Tranquille, Kamloops, Jun 1935, *E.W. Tisdale 40-11* (DAO); Lac du Bois, Tranquille, 21 Jul 1935, *E.W. Tisdale 40-11* (DAO); Squilax, 10 Aug 1935, *P.P. Henson s.n.* (DAO); Crescent Beach, 31 May 1937, *J.W. Eastham s.n.* (CAN); C. N. yards, Vancouver, 31 May 1937, *W. Sandall s.n.* (UBC); Nanaimo, 31 May 1939, *J.W. Eastham s.n.* (UBC); Kamloops, 14 Jun 1937, *J.H. Soper 1945* (DAO); Kamloops, 21 Jun 1937, *J.W. Eastham s.n.* (DAO); W Point Grey, Vancouver, 20 Jun 1937, *J.W. Eastham s.n.* (UBC); Marble Mts, Hat Creek Valley, 3000 ft, 26 Jun 1938, *J.W. Thompson & E. M. Thompson 227* (CAN, US); Lower Tranquille range, Kamloops, 22 May 1939, *E.W. Tisdale s.n.* (DAO); Prince Rupert-Terrace, Jul 1939, *C. C. King s.n.* (UBC); Terrace, 11 Aug 1939, *H. Groh 533* (DAO); Kamloops, 24 Jun 1940, *M.G. Dudley 246* (DAO); Locarno Park, Vancouver, 11 Jun 1944, *J.W. Eastham s.n.* (UBC); Gray Creek, 1 Jul 1944, *W.C. McCalla 8351* (UBC); Fort Steele, 12 Jul 1944, *W.B. Johnstone 495* (UBC); Kimberley, *F. Fodor 28*, 14 Jul 1946 (UBC); Osoyoos, 3 Jul 1947, *V.C. Brink s.n.* (UBC); Lytton, 175-500 m, 18 Aug 1949, *V.J. Krajina 1207* (UBC); Anarchist Mt, 19 Aug 1950, *V.J. Krajina s.n.* (UBC); Princeton, 19 Aug 1950, *V.J. Krajina s.n.* (UBC); Coyle, Merritt, 28 Aug 1950, *V. Krajina s.n.* (UBC); Chase, Kamloops, 28 Aug 1950, *V.J. Krajina s.n.* (UBC); 1 mi S of Osoyoos on W side of lake, 19 May 1953, *J.A. Calder & D.B.O. Savile 7899* (DAO); 10 mi SE of Hedley along Similkameen River, 26 May 1953, *J.A. Calder & D.B.O. Savile 8226* (DAO); along Nicola River about 5 mi SW of Spence's Bridge, 31 May 1953, *J.A. Calder & D.B.O. Savile 8457* (DAO); about 4 mi E of Kamloops on N side of S Thompson River, 2 Jun 1953, *J.A. Calder & D.B.O. Savile 8590* (DAO); about 4 mi S of Sicamous on E side of Mara Lake, 5 Jun 1953, *J.A. Calder & D.B.O. Savile 8749* (DAO); Westbank, 8 Jun 1953, *n.c.* (DAO); 24 mi S of Kootenay Bay along highway to Creston, 12 Jun 1953, *J.A. Calder & D.B.O. Savile 9047* (DAO); Goat River canyon at Erickson near Creston, 17 Jun 1953, *J.A. Calder & D.B.O. Savile 9285* (DAO, US); 2.5 mi E of Castlegar on highway between Nelson and Rossland, 20 Jun 1953, *J.A. Calder & D.B.O. Savile 9428* (DAO, UBC); Christina Lake, 29 Jun 1953, *G.H. Collin s.n.* (DAO); Westbank, 8 Jul 1953, *J.M. Smith s.n.* (DAO); Invermere townsite, 14 Jul 1954, *A. McLean s.n.* (DAO); Parksville, Vancouver Island, May 1955, *V.C. Brink s.n.* (DAO, UBC); Osoyoos, 12 May 1955, *D.R. Lindsay & W. Woodbury 595* (DAO); near Bowser, Qualicum Bay, Vancouver Island, 16 May 1955, *D.R. Lindsay & W. Woodbury 637* (DAO); Port Alberni, 17 May 1955, *D.R. Lindsay & W. Woodbury 660* (DAO); 20 mi N of Victoria, 19 May 1955, *D.R. Lindsay & W. Woodbury 725* (DAO); Patricia Bay Highway, one-half mi N of Royal Oak Corner, 20 May 1955, *D.R. Lindasy & W. Woodbury 753* (DAO); S of Steveston, Lulu Island, 24 May 1955, *D.R. Lindsay & W. Woodbury 770* (DAO); Abbotsford, 25 May 1955, *D.R. Lindsay & W. Woodbury 795* (DAO); Boston Bar, 30 May 1955, *D.R. Lindsay & W. Woodbury 861* (DAO); 4 mi S of Spence's Bridge, 31 May 1955, *D.R. Lindsay and W. Woodbury 884* (DAO); 5 mi N of Kamloops, 1 Jun 1955, *D.R. Lindsay & W. Woodbury 897* (DAO); 10 mi N of Merritt, Nicola Valley, 2 Jun 1955, *D.R. Lindsay & W. Woodbury 906* (DAO); Williams Lake, 5 Jun 1955, *D.R. Lindsay & W. Woodbury 971* (DAO); near Pavilion, 7 Jun 1955, *D.R. Lindsay & W. Woodbury 995* (DAO); 2 mi N of Vernon, 10 Jun 1955, *D.R. Lindsay & W. Woodbury 1023* (DAO); Lumby, 14 Jun 1955, *D.R. Lindsay & W. Woodbury 1073* (DAO); 10 mi S of Vernon, 15 Jun 1955, *D.R. Lindsay & W. Woodbury 1096* (DAO); 31 mi S of Williams Lake, 22 Jul 1955, *G.A. Mulligan & W. Woodbury 1762* (DAO); Fairview on Okanagan Falls to Oliver Rd, via Green Lake, 1650 ft, 11 May 1958, *K. Beamish 8161* (DAO); between Lytton and Lillooet, 4 Aug 1958, *T.M.C. Taylor, V. Krajina & F. Tusko 2* (UBC); Cranbrook, 12 Jul 1959, *E.W. Sullivan S59430* (DAO); Kaslo, Kootenay, 2200 ft, 21 Aug 1959, *M. Bell s.n.* (UBC); Indian Reserve E of Oliver, 4 May 1960, 1600 ft, *K. Beamish & E. Vrugtman 60102* (CAN); Indian Reserve E of Oliver, 4 May 1960, *J.W. Eastham 60102* (US); between Windermere and Fairmont Hotsprings, ca. 3000 ft, 13 May 1960, *K. Beamish & F. Vrugtman 60318* (UBC); Oliver campsite, 1100 ft, 17 May 1960, *K. Beamish & F. Vrugtman 60423* (UBC); Boy's Town, Hope-Princeton Hwy, 2300 ft, 11 Jul 1960, *K.I. Beamish & F. Vrugtman 60648* (DAO); Mt Kobau lookout trail, S Okanagan, 3500 ft, 8 Jul 1961, *J.W. Eastham 610412* (CAN, UBC); Esquimalt Lagoon, near Victoria, 7 May 1962, *J. Hett s.n.* (DAO); coast of Saanich Peninsula near Victoria, 11 May 1962, *J. Hett s.n.* (DAO); Esquimalt Lagoon Near Victoria, 29 May 1962, *J. Hett s.n.* (DAO); Manning Provincial Park, about 30 mi. SW of Princeton and 90 mi E of Vancouver, 4000-5000 ft, 26 Jun 1964, *H.J. Scoggan 15093* (CAN); Okanagan Range between Princeton and Penticton, 26 Jun 1964, *H.J. Scoggan 15044* (CAN); Nanoose Bay, 10 ft, 6 May 1965, *B.W. Davies 256* (DAO); Little Saanich Mtn, 400 ft, 17 May 1965, *B.W. Davies 390* (DAO); Esquimalt Lagoon, 1 Jun 1965, *B.W. Davies & R.A. Keller 700* (DAO); S of Kamloops, between Shumway and Trapp Lakes, 2300 ft, 23 Jun 1965, *V.J. Krajina*

(DAO); NW slopes above E end of Nicola Lake, 40 mi. S of Kamloops, 1900 ft, 23 Jun 1965, *V.J. Krajina 650623139* (UBC); 34 mi N of Princeton, 23 Jun 1965, *V.J. Krajina 650623192* (UBC); Beaver Pond, Manning Park, 14 Jul 1965, *I. L. Bayly 65-129* (DAO); S of Kamloops, 2830 ft, April 1966, *V.J. Krajina 65062303* (CAN, UBC); Island View Beach, Vancouver Island, 25 ft (7.6 m), 25 May 1966, *A.S. Harrison 29.1* (CAN); 2 mi N of Princeton, 2300 ft, 31 May 1966, *J. F. Alex 2258* (DAO); Aspen Grove, on W shore of Kidd Lake, along Hwy no. 5, 3000 ft, 22 Aug 1969, *J.H. Soper, M.J. Shchepanek & A.F. Szczawinski 12,662* (CAN); S Kelowna, 14 Jun 1970, *S. Kojima s.n.* (UBC); Manning Park, along Hope-Princeton Hwy, Beaver Pond area, 1189 m (3900 ft), 22 Jun 1973, *C.C. Chuang 118* (CAN); between Deese Lake and Telegraph Creek, 17 Jul 1973, *V.J. Krajina, R.G. McMinn, K. Klinka & R. M. Annas s.n.* (UBC); Botanie Valley road near Lytton, 1200 ft, 18 May 1974, *J. Pinder-Moss & J. Pojar 657* (UBC); Nanoose Hill, E side of Nanoose Bay, ca. 15 mi N of Nanaimo, Vancouver Island, < 500 ft, 27 May 1975, *K.I. Beamish, E. Perkins & S. Campbell 750045* (DAO); Ashnola Road, mile 23, 24 Jul 1975, *R. Hainault 7639* (DAO); Cathedral Park, 2 Jul 1976, *R. Hainault 7766* (DAO, UBC); Quesnel Region, S of Quesnel on Hwy 97, 16 Jul 1976, *M. Barkworth 1640* (DAO); Okanagan Game Farm, 1 mi NE of Kaleden, 1800 ft, 23 May 1977, *B. Wikeem & S. Gale s.n.* (UBC); W of Prentice Lake trail and N of Relay Creek, 1800 m, 16 Jun 1977, *C. Selby 20* (DAO, UBC); Hat Creek valley, 3300 ft, 23 Jun 1977, *R.K. Scagel 77-0-83* (UBC); above trail to Prentice Lake, plot 134 #880, 1580 m, 8 Aug 1977, *C. Selby s.n.* (DAO); Nanoose Hill, N of Nanaimo, 2-4 May 1980, *R. Turkington s.n.* (UBC); Kamloops, Lac du Bois Range behind Research Station, 23 Jun 1980, *S.G. Aiken 1062* (DAO); Kamloops Road to Todd Mt, 2800 ft, 30 Jun 1980, *S.G. Aiken 1118* (DAO); Opax Mountain, near Kamloops, 1 Jul 1980, *S.G. Aiken 1130* (DAO); Prison Camp, 20 km N of Clearwater Village, 8 Sep 1980, *T. Goward 81-815* (DAO); E of Princeton on Hwy 3 along Similkameen River, 31 Jul 1980, *H.L. Dickson & M. Picher 3757* (DAO); Kent District, Harrison Lake, Harrison Hot Springs, 10 Jul 1982, *S.G. Aiken & S.J. Darbyshire 2237* (DAO); Kalamalka Lake Park, near Vernon, 23 May 1984, *A. Ceska and R.T. Ogilvie 17659* (UBC); Meager Creek Hot Springs, N of Pemberton, Lillooet District, 650 m, 9 May 1987, *A.A. Rose s.n.* (UBC); below "The Throne", adjacent to the Haines Lease Ecological Reserve, N of Osoyoos Lake, 19 May 1987, *W.J. Crins & S.G. Cannings 7380* (UBC); Summerland, 30 Jun 1988, *J. E. Whiting 36* (UBC); Osoyoos area, Haynes Lease Ecoreserve, 13 May 1990, *T. Goward & T. Lea 90-593* (UBC); Christina Lake, 28 Aug 1990, *D.M. Tiedje 5581* (DAO); Abbotsford Distr. Munic., near base of Sumas Mt, 60-80 m, 25 May 1995, *H. Kennedy, F.R. Ganders, M. Marshall, D. Justice & L.Goertzen 4849* (UBC); 1.9 km up Kruger Mountain Road, S of Old Richter Pass Road, W of Osoyoos, 26 May 1995, *H.L. Dickson 8719* (DAO); Hope, above Fraser River, ca. 200 m., 1 Jun 1995, *H. Kennedy, F.R. Ganders & L. Thacker 4892* (UBC); Texada Island, off Harwood Point, at SE end of Dick Island, 2–5 m, 19 Jun 1997, *H. Janszen, P. Janszen & M. Fontaine 2659B* (UBC); 8 km E of Kamloops, 600 m, 11 Jun 1998, *P. Williston s.n.* (UBC); 12 km SW of Merritt, 27 Jul 1998, *P. Williston PW98-400a* (UBC); W perimeter of middle field on Basque Ranch (IR 18), 14 May 1999, *R. Bandringa 89* (UBC); Kootenay, Grand Forks, 30 Aug 1999, *R. Hebda s.n.* (UBC); edge of beach above wrack line, below University of British Columbia, 25 May 2005, *J.M. Saarela 316* (CAN, UBC); along Hwy 3, E of Hedly, 2.5 km W of Keremeos, gravel picnic area (rest stop), 18 May 2006, *J.M. Saarela 336* (CAN, UBC); Rocky Mountain Forest District, along Hwy 3, 1.5 km E of Elko, 23 May 2006, *J.M. Saarela 404* (CAN, UBC); Fort Steele Road, corner of Hwy 3 and Wardner, 12 km W of Jaffray, 23 May 2006, *J.M. Saarela 413* (CAN, UBC); Rampart Rest Area, 10 km E of Cranbrook, 23 May 2006, *J.M. Saarela 416* (CAN, UBC); ca. 2 km E of Erickson along Hwy 3, 24 May 2006, *J.M. Saarela 440* (CAN, UBC); 21.1 km W of Creston on Hwy 3A, 24 May 2006, *J.M. Saarela 446* (CAN, UBC); Kuskanook Rest Area, Kuskanook Harbour Society, 24 May 2006, *J.M. Saarela 450, 451* (CAN, UBC); Shady Lake Campground, 4.7 km S of Osoyoos at U.S.A./ Canada border, 25 May 2006, *J.M. Saarela 471* (CAN, UBC); Osoyoos, Haynes Provincial Park, 25 May 2006, *J.M. Saarela 485* (CAN, UBC); Richmond, London Farm, Gilbert Beach, just E of London's Landing, 28 May 2006, *J.M. Saarela & C. Sears 525* (CAN, UBC); Ladner, S side of Canoe Passage, W terminus of River Road, 28 May 2006, *J.M. Saarela & C. Sears 539* (CAN, UBC); 10 km W of Princeton on Hwy 3, 19 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 587* (CAN, UBC); Princeton, across from Princeton High School, 19 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 596* (CAN, UBC); N of Princeton, ca. 6 km along Iron Mountain Road, beyond 2nd fence, 19 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 603* (CAN, UBC); 1.9 km up Stemwinder Mountain Road, 19 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 608* (CAN, UBC); Fairview Road, ca. 4 km NE from intersection with Lowe Road, 19 Jun 2006, *J.M. Saarela, C. Sears & J. Maze 622* (CAN, UBC); University of British Columbia, beside Biological Sciences Building, 8 Sep 2006, *J.M. Saarela 761* (CAN).

18. Bromus vulgaris (Hook.) Shear, Bull. Div. Agrostol., U.S.D.A. 23:43, f. 24. 1900. **(Figs. 18J-L, 19C).**

Bromus purgans var. *vulgaris* Hook., Fl. Bor.-Amer. 2:252. 1840. *Bromus eximius* subsp. *umbraticus* Piper, Contr. U. S. Natl. Herb. 11:144. 1906, nom. illeg. superfl. *Bromopsis vulgaris* (Hook.) Holub, Folia Geobot. Phytotax. 8:169. 1973. *Zerna vulgaris* (Hook.) Henrard, Blumea 4:498. 1941. TYPE: U.S.A.: Columbia River, *Scouler s.n.* (LECTOTYPE: K, designated by Wagnon, Brittonia 7:459. 1952; ISOTYPE: US–A865457!, fragment ex. K).

Note: Hooker (1840:252) cited four collections when he described *B. purgans* var. *vulgaris*: "*Goldie. Dr Richardson.* Red River. *Douglas.* Columbia. *Dr Scouler*," and he cited "Fort Norman. *Dr Richardson*" following a description for a subvariety. Shear (1900) was the first to recognize *B. vulgaris* at the species level. He indicated that a spikelet from the Scouler specimen matched those of other taxa that he included as synonyms of *B. vulgaris* (i.e., *B. ciliatus* var. *pauciflorus* Vasey in Beal and *B. debilis* Nutt. ex Shear). Piper (1906) created a new name (*Bromus eximius* var. *umbraticus* Piper) for Shear's taxon, indicating that it is not the same as *B. purgans* var. *vulgaris* Hook., seemingly unaware that some of the material that Hooker examined is indeed *B. vulgaris* in the sense of Shear (1900). Wagnon (1952) recognized *B. vulgaris* Shear and placed Piper's new name for this taxon into its synonymy. Wagnon (1952) indicated that he observed all of Hooker's original material at Kew except "*Goldie. Dr. Richardson.*" He noted that the Douglas collection (two specimens) from "Red River" is *B. kalmii* Gray; Richardson's "Fort Norman" collection is *B. inermis* var. *purparascens* (=*B. inermis* Leyss.); and Dr. Scouler's collection from "Columbia [River]" is *B. vulgaris*, in the sense of the taxon according to Shear (1900), who saw a spikelet from the same collection. This concept of *B. vulgaris* has been taken up by all subsequent authors. Wagnon (1952) further noted that Richardson and Goldie collected (independently) east of the Rocky Mountains, outside the range of *B. vulgaris*, and suggested (reasonably) that their collections are likely different *Bromus* taxa. Wagnon (Brittonia 7:459. 1952) designated the Scouler collection as the type [lectotype] of *B. purgans* var. *vulgaris*, making *B. eximius* var. *umbraticus* a superfluous illegitimate name. His choice of this specimen as lectotype is not in conflict with the original protologue for the name, since the brief description given is not sufficiently detailed to distinguish among the mixed taxa that Hooker examined. Pavlick et al. (2003) erroneously indicated that the correct name for *B. vulgaris* (Hook.) Shear is *B. eximius* subsp. *umbraticus* Piper, and did not indicate that Wagnon (1952) lectotypified *B. purgans* var. *vulgaris*, since they listed Hooker's original material as syntypes and included the independent collections of Goldie and Richardson as a single collection.

Bromus vulgaris var. *eximius* Shear, Bull. Div. Agrostol., U.S.D.A. 23:44. 1900. *Bromus eximius* (Shear) Piper, Contr. U.S. Natl. Herb. 11:143. 1906. TYPE: U.S.A. OREGON. Wallowa Co.: on moist, open mountain side 4 mi above Wallowa Lake, 23 Aug 1899, *C.L. Shear 1791* (HOLOTYPE: US-81575!).

Bromus vulgaris var. *robustus* Shear, Bull. Div. Agrostol., U.S.D.A. 23:44. 1900. *Bromus eximius* var. *robustus* (Shear) Piper, Contr. U.S. Natl. Herb. 1:143. 1906. TYPE: U.S.A. OREGON. Clatsop Co.: in moist thickets near the seashore, Seaside, 11 Aug 1899, *C.L. Shear & F.L. Scribner 1710* (ISOTYPE: US-81576!).

Bromus ciliatus var. *glaberrimus* Suksd., Deutsche Bot. Monatsschr. 19:93. 1901. TYPE: U.S.A. WASHINGTON. Skamania Co.: 22 Jul 1894, *W.N. Suksdorf 2335* (ISOTYPES: GH–234940, US–228545! with the additional locality information: "near the Ice Cave").

Perennial; rhizomes absent; plants 45–125 cm tall. Culms 2–5(–9) mm wide at base, smooth; nodes (3–)4–6(–7), brown, glabrous or finely to densely retrorsely pubescent, hairs to 0.7(–1) mm long, occasionally with denser hairs above nodes; lower nodes covered by sheaths. Leaf sheaths closed for most of their length, glabrous or sparsely to densely pilose with hairs to 1.2 mm long; auricles absent; ligules (2–)3–6(–7) mm long, membranous, glabrous, erose; blades 12–33 cm long, 3–16 mm wide, thin and papery when dry, adaxial surface sparsely to densely pilose, hairs to 1 mm long, soft and wavy, abaxial surface glabrous, margins smooth or serrulate. Panicles 8–25 cm long, 1–5 cm wide, narrow, branches erect to ascending or drooping, shorter or longer than spikelets, branches scabrous-pubescent, 1(–2) spikelets per branch, lowest inflorescence node with 1–5 branches. Spikelets 1.5–3 cm long, ovate-lanceolate, terete to slightly compressed, rachilla sometimes visible at maturity; florets 3–9. Glumes subequal, lanceolate, glabrous or pubescent, hairs sometimes restricted to margins and keel; lower glumes 4–9 mm long, 1(–3)-nerved, lanceolate; upper glumes 5–11 mm long, 3-nerved, sometimes mucronate, mucros to 0.5 mm long. Lemmas 10–16 mm long, 7-nerved, 1.2–2 mm wide, margins glabrous to sparsely or densely pubescent, backs glabrous to variously pubescent, hairs to 1 mm long, sometimes denser on lower ½; apex entire or minutely bifid, the cleft to 0.3 mm deep; awns (4–)6–11 mm long, arising 0–0.5 mm below lemma apex, straight, antrorsely scabrous. Paleas 7.5–11 m long, shorter than lemmas, keels densely ciliate, cilia to 0.5 mm long. Stamens 3; anthers 2–3.5(–4) mm long, dark brown. $2n = 14$.

Distribution and Habitat.—Native. In North America, *B. vulgaris* occurs in British Columbia, southwestern Alberta and south to western Wyoming and south–central California (Pavlick & Anderton 2007). *Bromus vulgaris* occurs throughout the southern half of British Columbia (Fig. 19C). It was only recently reported from Moresby Island (Queen Charlotte Islands; Lomer & Douglas 1999). A 2007 collection [*Saarela & Percy 1169* (CAN, UBC)] represents the first record of *B. vulgaris* from the neighbouring Graham Island. Habitats include moist woods, stream banks, damp thickets, along trails, meadows and rocky banks. Elevation 0–2286 m.

Common Names.—Columbia brome, narrow-flowered brome, common brome.

Notes.—In herbarium material of *B. vulgaris*, leaf blades tend to appear conspicuously thin and papery compared to those in other species of *B.* sect. *Bromopsis*, though it is difficult to adequately describe this qualitative characteristic. This characteristic does not seem to be as evident in the field. At present, there are no leaf blade anatomical data for North American *B.* sect. *Bromopsis* species which might allow further evaluation of this character.

Representative Specimens Examined. **CANADA. British Columbia:** Selkirk Range, 17 Aug 1885, *Macoun 30,005* (CAN); Roger's Pass, Selkirk Mtns, 18 Aug 1885, *J. Macoun 30005*; Nanaimo, 7 Jun 1887, *J. Macoun s.n.* (US); Goldstream, Vancouver Island, 5 Jul 1887, *Macoun 30009* (CAN); Goldstream, Vancouver Island, 5 Jul 1887, *Macoun 30,010* (CAN, US); Deer Park, Lower Arrow Lake, 18 Jun 1890, *Macoun 30014* (CAN, US); Middle Selkirk Mts, Rogers Pass, 4500 ft, 1 Aug 1890, *Macoun 11084* (CAN, US); Selkirk Mts, Rogers Pass, 4 Aug 1890, *Macoun 30007* (CAN); Nanaimo, Vancouver Island, 14 Jul 1893, *Macoun 135* (CAN); Cameron Lake, Vancouver Island, Jul-Aug 1899, *Fletcher 2213.5* (DAO); Chilliwack River, 19 Jun 1901, *J.M. Macoun 26060* (CAN, US); Chilliwack Valley, 21 Jun 1901, 1800 ft, *J.M. Macoun 26063* (US); Chilliwack Lake, 2500 ft, 22 Jul 1901, *J.M. Macoun 26062* (CAN, US); Chilliwack River, 2 Aug 1901, *J.M. Macoun 26064* (CAN, US); Chilliwack River, 8 Aug 1901, 2000 ft, *J.M. Macoun 26061* (CAN, US); Vancouver Island, 31 Jul 1902, *C.O Rosendahl 856* (US); Vancouver, 22 Jul 1902, *C.O. Rosendahl 802* (US); Skagit Valley, 24 Jun 1905, *J.M. Macoun 72949* (CAN, US); Glacier, Illecillewaet Valley, Loop Trail, 3500–4000 ft, 20 Jul 1906, *S. Brown 656* (CAN); vicinity of Victoria, 18 Jun 1908, *J. Macoun 78833* (US); head of Departure Bay, 23 Jun 1908, *J. Macoun 76,848* (US); Departure Bay, near Biological Station, 3 Jul 1908, *Macoun 76846* (CAN, US); Mt Benson near Nanaimo, 13 Jul 1908, *J. Macoun s.n.* (US); vicinity of Victoria, 20 Jul 1908, *J. Macoun 76845* (US); Colquitz River near Victoria, 20 Jul 1908, *Macoun 76,850* (CAN, US); S shore of Cowichan Lake, 15 Jun 1909, *C.O. Rosendahl 1819* (US); Bear Lake, 3 Jul 1911, *W. Spreadborough 87613* (US); Bear Lake, 5 Jul 1911, *W. Spreadborough 87601* (US); Eburne, 3 Jun 1912, *J. Davidson s.n.*(UBC); Sidney, 7 Jul 1913, *M.O. Malte 28* (CAN); vicinity of Sidney, 12 Jun 1913, *J. Macoun s.n.* (V); Mayne Island, 4 Jun 1914, *J.M. Macoun 90083* (CAN); Oak Bay, near Victoria, 17 Jun 1913, *J. Macoun 88,528* (CAN); Vancouver Island, Alberni, Jun 1916, *W.R. Carter 906* (CAN); Cascade Range, near head of McGillivray Creek, 5000 ft, 10 Aug 1916, *J.M. Macoun 94,020* (CAN, US); Cascade Range, within five miles of Lillooet, 22 Jul 1916, 3000 ft, *J.M. Macoun 93,966* (CAN); Cascade Range, within five mi of Lillooet, 2500 ft, 22 Jul 1916, *J.M. Macoun 93,970* (CAN); Cascade Range, near head of McGillivray Creek, 5000 ft, 12 Aug 1916, *J.M. Macoun 93,976* (CAN); Kootenay, Crawford Bay, 20 Jun 1918, *J.W. Kidman s.n.* (UBC); Sidney, 4 Jul 1921, *M.O. Malte 106,800* (CAN, DAO); Vancouver Island, Cowichan Lake, 25-26 Aug 1931, *V. Kujala and A. Cajander s.n.* (CAN); Vancouver Island, Victoria, Goldstream, 11-12 Sep 1931, *V. Kujala & A. Cajander s.n.* (CAN); Tabor Lake (Six-mile Lake), 6 mi E of Prince George, 14-18 Jul 1931, *V. Kujala & A. Cajander s.n.* (CAN); Mt between Chilliwack and Hope, 3000 ft, 9 Jul 1932, *E. P. Hume s.n.* (UBC); Athabasca Mill, Nelson, 4000 ft, 16 Jul 1937, *J.W. Eastham 403* (UBC); Venus Mine, Nelson, 5000 ft, 18 Jul 1937, *J.W. Eastham 404c* (UBC); Hollyburn Trail, 1 Jul 1938, *J.W. Eastham 406a* (UBC); Beacon Hill Park, Victoria, 2 Jun 1938, *J.W. Eastham 849* (UBC); Rossland Highway, Grand Forks, 18 Jul 1938, *J.W. Eastham s.n.* (DAO, UBC); Victoria, 11 Jun 1939, *J.W. Eastham s.n.* (DAO); Qualicum Falls Park, Vancouver Island, 31 Jun 1939, *J.W. Eastham 401* (UBC); Mt Revelstoke, 3000 ft, 18 Jul 1939, *H. Groh 186* (DAO); Goldstream Lake, Vancouver Island, 13 Jun 1940, *I. Cowan 8156* (UBC); Mavis Lake, Vancouver Island, 13 Jun 1940, *I. Cowan 8166* (UBC); Long Beach, Nelson, 17 Jun 1940, *J.W. Eastham 7384* (UBC); Nelson, 25 Jun 1940, *J.W. Eastham 7540* (UBC); Lightning Peak Road, Monashee, 5000 ft, 14 Jul 1940, *J.W. Eastham 7851* (UBC); Parksville, Vancouver Island, 10 Jun 1941, *J.W. Eastham 8887* (UBC); Cultus Lake, Chilliwack, 11 Jun 1941, *J.W. Eastham 8897* (UBC, US); Seymour Park, N shore, 21 Jun 1941, *J.W. Eastham 8953* (UBC, US); Alberni, Vancouver Island, 10 Aug 1941, *J.H. Soper 8378* (DAO); Arrowsmith Trail, Cameron Lake, 14 Aug 1941, *J.W. Eastham 9436* (UBC); W Vancouver, 15th Street, 20 Jun 1943, *J.W. Eastham 10834a* (UBC); Manning Park, 4000 ft, 25 Jul 1945, *G.A. Hardy 14240* (UBC); Aleza Lake, 23 Jul 1946, *J.W. Eastham 14809* (UBC); Vancouver, 120 ft, 19 Jul 1949, *V. Krajina 74* (UBC); Botanic Valley, 22 Aug 1949, *V.J. Krajina s.n.* (UBC); Salmon River Valley 15 mi S of Sayward, 65 m, 3 Jun 1950, *V. Krajina & R.H. Spilsbury 4302* (UBC); Qualicum Beach, 25 Jun 1950, 10 m, *V. Krajina, R.H. Spilsbury & A. Szczawinski 4591* (DAO, UBC); Vancouver Island, Wolf Mountain, 300 m, 27 Jul 1950, *V. Krajina, R.H. Spilsbury, & A. Szczawinski 5171* (UBC); MacMillan Park, 185 m, 8 Aug 1950, *V. Krajina, R.H. Spilsbury & A. Szczawinski 5331* (UBC); Goodchap Mt, E of Apex Mt near Penticton, 5-7500 ft, 27 Jul 1950, *D. Martin s.n.* (UBC); 0.5 mi W of 2nd Lake, 29 Jul 1950, *V. Krajina, R.H. Spilsbury & A. Szczawinski 5195* (DAO); Vancouver Island, MacMillan Park, 185 m, 8 Aug 1950, *V. Krajina, R.H. Spilsbury & A. Szczawinski 5329* (UBC); under Monashee Pass, 10 Jul 1952, *V.J. Krajina s.n.* (UBC); middle Nanaimo River Valley, 700 ft, 16 Jun 1955, *D. Mueller-Dombois 22-8* (UBC); Ganges, 30 Jun 1956, *T.R. Ashlee 36* (UBC); Nanaimo River Valley, 700 ft, 11 Jul 1955, *D. Mueller-Dombois 40-1* (UBC); Boundary Creek 10 mi N of Greenwood, 30 Jul 1956, *A. McLean s.n.* (DAO); W Nanaimo River Valley, 1115 ft, 6 Aug 1957, *D. Mueller-Dombois 18-1* (UBC); 9.5 mi on road from Beaver Lake to Likely, NW of Williams Lake, 28 Aug 1956, *J.A. Calder, J.A. Parmelee & R.L. Taylor 20505* (DAO); Du Hamel Lakes, Nelson, Kootenay, 26 Jul 1958, *M. Bell s.n.* (UBC); Sugar Lake, Cherryville, 28 Jun 1958, *M. Bell s.n.* (UBC); Big Qualicum River, Vancouver Island, 13 Jul 1959, *L. Holm 524* (UBC); Nakusp, Kootenay, 2400 ft, 22 Jul 1959, *M. Bell s.n.* (UBC); E side of Lightning Lake, Manning Park, 4000 ft, 13 Jul 1960, *K.I. Beamish & F. Vrugtman 60756* (DAO, UBC); Head of Finlayson Arm, N of Victoria, 16 Jul 1961, *J.A. Calder & K.T. Mackay 31521* (DAO); Gail Falls on Kelsey Bay-Campbell River road, 12 Aug 1961, *J.A. Calder & K.T. MacKay 32432* (DAO); Sarita River, 50 ft, 14 Jun 1963, *A. Yound & W. Hubbard 395* (DAO); 1 mi E of Pilot Mountain Lookout, ca. 15 mi NE of Prince George, 1 Jul 1963, *A. Auclair 15* (DAO); Kennedy River area, drainage of Kennedy River, 2 Jul 1963, *A. Young & W. Hubbard 226* (DAO); Pilot Mountain Road, 1 mi E of the lookout, 2000 to 2400 ft, 2 Jul 1963, *A. Auclair & S. Eis s.n.* (DAO); Lawless Creed Road, 13.6 mi W of Tulameen, NW of Princeton, 4500 ft, 16 Jul 1964, *A. McLean s.n.* (DAO); Mt Revelstoke National Park, 2040 ft, 22 Jun 1965, *V.J. Krajina 65062233* (UBC); Copper Mtn Road, 2.7 mi S of rock cut, S of Princeton, 5800 ft, 6 Aug 1964, *A. McLean s.n.* (DAO); E end of Durrance Lake, Vancouver Island, 134 m, 18 Jul 1967, *A.S. Harrison 37.2* (CAN); McLeod Lake, 2250 ft, 19 Jul 1967, *V.J. Krajina & Revel s.n.* (UBC); Vancouver Island, Strathcona Provincial Park, 9 Sep 1967, *K. Beder, V. Bedanr, S. Kojima & V.J. Krajina s.n.* (UBC); Vancouver Island, Mill Hill, near Langford, 1 Jul 1969, *J.H. Soper, M.J. Shchepanek & A.F. Szczawinski 12243* (CAN); Vancouver Island, MacMillan Park, near Cameron Lake, 650 ft, 8 Jul 1969, *J.H. Soper, M.H. Shchepanek & A.F. Szczawinski 12403* (CAN); Strathcona Provincial Park, 250 m, 8 Jul 1969, *S. Kojima s.n.* (UBC); Upper Sage Creek Valley, 5200 ft, 20 Jul 1970, *K.I. Beamish, M. Bell & N. Anderson 756* (UBC); upper Sage Creek, 20 Jul 1970, *K. Beamish, M. Bell & N. Anderson 756* (CAN); Mount Revelstoke Robson Park, 3350 ft, 20 Aug 1970, *V.J. Krajina s.n.* (UBC); National Park, along Trail no. 10, mile 7, Summit Road, 3,750 ft, 30 Jul 1970, *J.H. Soper & M.J. Shchepanek 12740* (CAN); Mount Revelstoke National Park, W Woolsey Creek (Silver Creek), along trail no. 6, W Fork Woolsey Trail, 3 Aug 1970, *J.H. Soper & M.J. Shchepanek 12809* (CAN); Glacier National Park, Bald Mountain Trail to Grizzly Creek, at Beaver River crossing, 3600 ft, 27 Jul 1972, *E. Haber & M.J. Shchepanek 1634* (CAN); Manning Park, Poland Lake area, 1768 m, 7 Aug 1973, *C.C. Chuang 1056* (CAN); Point No Point, 23 Jul 1974, *Hainault & Tanguay 7691* (DAO); ca. 25 mi NW of Prince George on the N bank of the Fraser River, along the apex of its "big bend", 2000 ft, 30 Jul 1974, *V.J. Krajina, J. Pojar & C. Parsons s.n.* (UBC); Quesnel

Region, 17 mi E of Quesnel on Barkerville Road, 17 Jul 1976, *M. Barkworth 1634* (DAO); C.F.B. Kamloops, Mt Lolo, 22 Jul 1976, *M. Barkworth 1742* (DAO); Power River, W coast of Vancouver Island, 26 Jun 1979, *C.E. Jones s.n.* (DAO, UBC); W central Vancouver Island, 195 m, 20 Jun 1980, *D. Gagnon & G. A. Spiers 80-60-11* (UBC); Mt Lolo, 3 Jul 1980, *B. Brookes 1171* (DAO); Vancouver Island, Shawnagan Lake Port Renfrew Road ca. 12 mi W of Shawnagan Lake, 2 Aug 1980, *H.L. Dickson, M. Piche, D. Moennich, C. Barnard & R. Barnard 3790* (DAO); Lolo Mtn, 12 km E of Kamloops, 23 Aug 1980, *B.M. Brooke s.n.* (DAO); Vancouver Island, Goldstream Provincial Park, 30 Jun 1982, *S.G. Aiken, S.J. Darbyshire & L.E. Pavlick 2104* (DAO); W coast Vancouver Island, Pachena Bay, SW of Bamfield, West Coast Trail, 7 Jul 1982, *S.G. Aiken, S.J. Darbyshire & L.E. Pavlick 2214* (DAO, UBC); E of Kersley on Hwy 97, S of Quesnel, 2400 ft, 14 Jul 1982, *S.G. Aiken, S.J. Darbyshire & A. Roberts 2321* (DAO); Cariboo District, Timothy Mountain near Lac La Hache, 5454 ft, 18 Jul 1982, *S.G. Aiken & S.J. Darbyshire 2389* (DAO); E side of Matthew River, 930 m, 17 Aug 1982, *L.E. Pavlick 82-346* (V); Lower Fraser Valley, Mount McGuire, NE ridge, 6 Sep 1984, *Ceska 18066* (UBC); Goldstream Provincial Park, E side of Finlayson Arm, just outside park boundary, 30 Jun 1988, *S.J. Darbyshire 3739* (CAN); Saltspring Island, S end, Musgrave Road to Mount Bruce, 3 Jul 1988, *S.J. Darbyshire & J. A. Darbyshire 3769* (CAN, DAO); Skye Meadows Ecological Reserve, SE of Chilliwack, 2 Jul 1989, *G.B. Straley, R. Klinkenberg & B. Klinkenberg 5561* (UBC); Vancouver Island, Goldstream Park, 31 Aug 1993, *J. Cayouette & S.J. Darbyshire C7503* (DAO); Vancouver Island, 2-3 km E of Lizard Lake, 2 Sep 1993, *J. Cayouette, S.J. Darbyshire & L.E. Pavlick C7516* (DAO); Vancouver Island, Port Alberni, near mouth of Somass River, 11 Sep 1993, *J. Cayouette C7586, C7600* (DAO); Queen Charlotte Islands: Moresby Island, 6 km SSE of Sandspit, roadside next to Blaine Ck., 3 m, 18 Jul 1997, *F. Lomer & N. Grove 97403* (UBC); campground at Dragon Lake, 12 mi NE of New Aiyansh on road towards Cranberry Junction, 22 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18694* (CAN, US); 9 mi NE of New Aiyansh on road towards Cranberry Junction, 22 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18699* (CAN, US); Maroon Mountain Trail from end of road to ridge top, 23 Jul 2004, *P.M. Peterson, J.M. Saarela & S. Smith 18726* (US, UBC); Mayne Island, Bennett Bay, Gulf Islands National Park Reserve of Canada, Wilkes Road off Bennett Bay Road, 3 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 822* (CAN, UBC); Vancouver Island, Saanich Peninsula, at corner of Derrick Road and Norris Road, S of Deep Cove, 4 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 838* (CAN, UBC); Vancouver Island, Thetis Lake Regional Park, just N of Hwy 1, N of Langford, 4 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 853* (CAN, UBC); Vancouver Island, along Deering Road ca. 3 km N of Port Renfrew, 5 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 886* (CAN, UBC); Vancouver Island, 7.9 km along Horne Lake Road W of Hwy 19, 8 Jun 2007, *J.M. Saarela, D.M. Percy & Y. Chang 975* (CAN, UBC); Queen Charlotte Islands, Graham Island, Towhill Ecological Reserve, along small ecozone road to beach, Naikoon Provincial Park, 22 Jul 2007, *J.M. Saarela & D.M. Percy 1169* (CAN, UBC); Queen Charlotte Islands, Moresby Island, 21.5 km SW of Sandspit, E of Skidegate Lake, 0.3 km W of bridge at km marker 13, 2.2 km W of Y junction, 25 Jul 2007, *J.M. Saarela & D.M. Percy 1294* (CAN, UBC); Queen Charlotte Islands, Moresby Island, 12.7 km S of Sandspit, 25 Jul 2007, *J.M. Saarela & D.M. Percy 1296* (CAN, UBC); Queen Charlotte Islands, Moresby Island, 11.2 km S of Sandspit, adjacent to Copper Bay, 25 Jul 2007, *J.M. Saarela & D.M. Percy 1300* (CAN, UBC); W of Smithers, along Hudson Bay Mountain Road, between Smithers and alpine ski area, *J.M. Saarela & D.M. Percy 1344* (CAN, UBC).

Notes on Excluded Species

There is a single, early collection of *B. arvensis* L. (field brome) from British Columbia [Invermere, 29 Jul 1915, *M.O. Malte 108375* (CAN!, DAO!)]. In his distribution maps, Pavlick (1995) indicated that *B. arvensis* occurs in British Columbia, probably based on this collection. The annual *B. arvensis*, a species classified in *B.* sect. *Bromus*, is native to Europe; it occurs in scattered locations across North America, more commonly in the eastern U.S.A. (Pavlick & Anderton 2007). It is not known if *B. arvensis* species persists in British Columbia; it therefore is not formally treated here. Should the species be collected again in British Columbia, it can be distinguished from other *B.* sect. *Bromus* species in the province as follows: anthers 2.5–5 mm [vs. anthers < 2.5(–3) mm]; linear-lanceolate spikelets that narrow only slightly towards their apex [vs. ovate-lanceolate spikelets that narrow conspicuously towards their apex]; lower leaf sheaths with dense, softly appressed hairs 0.4–0.6 mm long [vs. lower leaf sheaths glabrous, sparsely to densely pilose with stiff hairs 0.5–0.6 mm long, or with soft and wavy hairs to 1.2 mm long]; and often purple-tinged spikelets (this colouration is not always present in dried specimens).

Taylor and Macbride (1977) reported *B. rubens* L. [=*B. madritensis* subsp. *rubens* (L.) Husn.] from British Columbia. Following this report, Salo (2005) indicated that red brome occurs in British Columbia, but she did not include any specimens on her distribution maps. There is a single collection of this species from British Columbia, collected over a century ago (Nanaimo, Vancouver Island, 13 Jul 1893, *Macoun 118* CAN-39043!, photo: DAO-56101!). The species seems not to have persisted in British Columbia and it is therefore not treated here.

Scoggan (1978:252) noted that *B. orcuttianus* Vasey had been previously reported from near Victoria, Vancouver Island. *Bromus orcuttianus* does not occur in British Columbia (see Saarela et al. 2005).

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